

# **Science and Religion**

**Professor Lawrence M. Principe**



**THE TEACHING COMPANY ®**

## **Lawrence M. Principe, Ph.D.**

Professor of History of Science and Technology and of Chemistry,  
Johns Hopkins University

Lawrence Principe did his undergraduate work at the University of Delaware, where he received a B.S. in chemistry and a B.A. in liberal studies in 1983. During this time, he developed his interest in the history of science, particularly the history of alchemy and early chemistry. He then entered the graduate program in chemistry at Indiana University, Bloomington, where he worked on the synthesis of natural products. Immediately upon completing the Ph.D. in organic chemistry (1988), he reentered graduate school, this time in history of science at Johns Hopkins University, and earned a Ph.D. in that field in 1996.

Since 1989, Professor Principe has taught organic chemistry at Johns Hopkins University. In 1997, he earned an appointment in history of science. Currently, he enjoys a split appointment as professor between the two departments, dividing his teaching equally between the two at both graduate and undergraduate levels. He also enjoys annoying safety inspectors by performing alchemical experiments in his office.

In 1999, Professor Principe was chosen as the Maryland Professor of the Year by the Carnegie Foundation; in 1998, he received the Templeton Foundation's award for courses on science and religion; and in 2004, he was the first recipient of the prestigious Francis Bacon Award for History and Philosophy of Science. He has also won several teaching awards bestowed by Johns Hopkins University.

Professor Principe's interests cover the history of science of the early modern and late medieval periods and focus particularly on the history of alchemy and chemistry. His first book was entitled *The Aspiring Adept: Robert Boyle and His Alchemical Quest* (1998), and he has since collaborated on a book on 17<sup>th</sup>-century laboratory practices (*Alchemy Tried in the Fire*, winner of the 2005 Pfizer Prize) and on a study of the image of the alchemist in Netherlandish genre paintings (*Transmutations: Alchemy in Art*). He is currently at work on a long-term study of the chemists at the Parisian Royal Academy of Sciences around 1700.

## Table of Contents

### Science and Religion

<b>Professor Biography</b> .....	i
<b>Course Scope</b> .....	1
<b>Lecture One</b> Science and Religion .....	2
<b>Lecture Two</b> The Warfare Thesis .....	4
<b>Lecture Three</b> Faith and Reason—Scripture and Nature .....	7
<b>Lecture Four</b> God and Nature—Miracles and Demons.....	10
<b>Lecture Five</b> Church, Copernicus, and Galileo.....	13
<b>Lecture Six</b> Galileo’s Trial.....	16
<b>Lecture Seven</b> God the Watchmaker .....	18
<b>Lecture Eight</b> Natural Theology and Arguments from Design .....	21
<b>Lecture Nine</b> Geology, Cosmology, and Biblical Chronology.....	24
<b>Lecture Ten</b> Darwin and Responses to Evolution.....	27
<b>Lecture Eleven</b> Fundamentalism and Creationism.....	30
<b>Lecture Twelve</b> Past, Present, and Future.....	33
<b>Timeline</b> .....	35
<b>Glossary</b> .....	37
<b>Biographical Notes</b> .....	40
<b>Bibliography</b> .....	44

## Science and Religion

### Scope:

Science and religion are unquestionably two of the most potent forces that have shaped—and continue to shape—human civilization. How have these powerful forces interacted over time? What are the bases, terms, and varieties of their interactions? Popular opinion generally assumes an antagonistic relationship between the two, but modern scholarship increasingly reveals this as a one-sided view that is not only relatively recent but also self-servingly propagated to this day by extremist voices in both the religion and the science camps. This course's approach to the issue is both historical and philosophical. It examines several historical episodes that highlight features of “science and religion” and analyzes in context the questions and issues that these episodes raise.

We begin by probing the very nature of science and religion: How are they different and how are they similar in terms of their questions, methods, and sources of knowledge and certainty? Science and theology turn out to have more in common than is generally believed. Thereafter, we examine various models that have been proposed for the interactions between science and religion and reveal the political origins of the still-popular *warfare thesis*. The course then embarks on a largely chronological study of important and illustrative episodes. These episodes include the famous cases of Galileo Galilei's moving Earth and the (continuing) fallout from Charles Darwin's theory of evolution, as well as issues relating to the age of the Earth and the origin of life. We will also examine notions regarding the level of God's involvement in the running of the cosmos; the roles of miracles, angels, and demons; and the problems of correctly identifying them. We will look at varieties of biblical interpretation and the highly varied readings of biblical narratives (especially Genesis 1) in different epochs and among different denominations, as well as the rise and fall of natural theology and its modern cousin, *intelligent design*. Our sources will be not only historical, scientific, and theological texts but also recent documents and events that serve to bring our discussions down to the present day.

Throughout the course, historical episodes are placed in their proper context and closely analyzed as we endeavor to get at the real issues involved. In some cases, we discover that the issues were not actually science and religion interactions, and in other cases, we find some issues that remain unresolved today, no matter how much partisans of rigidly scientific and rigidly religious viewpoints try to overlook them. Throughout, we will see how the strict division of “scientific” and “religious” thought is a modernism that cannot be “read back” into history. Indeed, much of the course reveals science and theology, faith and reason, as two individually incomplete methods—sometimes harmonious, sometimes not—that human beings have used in their endless quest for understanding.

## Lecture One

### Science and Religion

**Scope:** In this introductory lecture, we define the basic terms of the course, its content, methodology, and focus. This course deals with the interactions of Christianity with science in the Western world over a long time span. We also look more closely at the terms *science* and *religion* in order to prepare ourselves for consistent discussions in future lectures. Finally, we look briefly at the various models for the interactions of science and religion that have been proposed, critique them, and provide some pointers for engaging with the balance of the course.

### Outline

- I. Science and religion are two of the most important influences on human civilization.
  - A. This has been the case both in the past and the present.
  - B. These two important topics have often had occasion to interact.
  - C. This course will examine historical episodes in order to explore the various interactions that science and religion have had.
- II. It is important, first of all, to define the basic terms and parameters of this study.
  - A. This course focuses on the interactions of science and religion in the Latin West and its direct descendants (Western Europe and North America).
    1. This choice is based on the fact that not only modern science but most listeners (North Americans) are products most directly of the Latin West; thus, this domain presents both the most significant and the most relevant examples.
    2. Consequently, the religion discussed here is predominantly Western Christianity.
  - B. The approach and content of this course are predominantly historical but also, to some extent, philosophical.
    1. Many issues are long-lived; thus, there is an attempt to link historical episodes with their modern-day equivalents.
    2. The emphasis is on scientific and theological *knowledge*; therefore, ethical issues are not treated.
  - C. Definitions of science and religion can skew our study if they are too rigid or drawn too naively from modern experience. Modern experience may not “map out” on the historical past.
    1. What counts as science (or religion) is, to a considerable extent, determined by the historical context; its definition is not rigidly fixed.
    2. Some broad, common definitions are useful, if we keep them flexible enough to grow under the influence of historical studies.
  - D. *Science*, in common parlance, is both a body of knowledge claims and a practice; it deals with the knowledge and study of the *natural* world.
  - E. *Religion* is difficult to define neatly; more useful and more precise terms are *religious practice*, *theology*, and *faith*.
    1. *Religious practice* can be defined as the observances and practices that flow from a religious commitment (attendance at church, works of charity, moral self-discipline, and so on).
    2. *Theology* is “a rational discourse about God”; that is, it is the intellectual and methodical study of God and the spiritual world and God’s attributes, actions, and relationship to creation.
    3. Like science, theology is both a body of knowledge claims and a practice of generating them.
    4. *Faith* is a method (through belief or suspended disbelief) of arriving at some knowledge claim, for example, “that God exists.”
    5. These three concepts are interconnected, but individuals combine them in different ways and proportions.

- F. A useful pair of terms is *faith* and *reason*—both are methods of arriving at knowledge claims but by different routes.
1. It is sometimes claimed that religion works by faith and science by reason and that this is the basis of their distinction; however, this claim is too sloppy.
  2. Science must often depend on faith statements even though it uses reason extensively; likewise, theology relies on the exercise of reason.
  3. Science and theology share considerable commonality and are (more rigorously speaking) the domains to be compared in this course.

III. Various models of the science-religion interaction have been proposed.

- A. The most common is the warfare model; this will be dealt with at length in Lecture Two.
- B. Another model is the separate realms model. It argues that science and religion address different domains, and by consequence, any conflict is a result of boundary transgressions.
1. But this model relies upon *a priori*, modern, and sometimes idiosyncratic definitions of science and religion.
  2. Christian theology *does* make specific claims about the natural world, for example, that the world is not eternal.
  3. Likewise, science makes claims about the natural world that have direct bearing on theological claims.
  4. Trying to erect fences between science and religion is reactionary and, ultimately, *normative*. Historical inquiry cannot be normative; it has to be descriptive, analytical, and explanatory.
- C. Various forms of the *complexity thesis* have been proposed using such terms as *translation*, *appropriation*, *assimilation*, and *cross-fertilization*. This model relies on contextualized case studies to illustrate the diverse and complex interactions of science and religion.

**Essential Reading:**

John Hedley Brooke, *Science and Religion: Some Historical Perspectives*, pp. 1–33.

Margaret Osler, “Science and Religion in Early Modern Europe,” *History of Science* 36 (1998): 91–113.

**Supplementary Reading:**

Stephen J. Gould, *Rocks of Ages: Science and Religion in the Fullness of Life*.

**Questions to Consider:**

1. Take some time to consider the bases of your own knowledge. How do you know what you know (about scientific ideas or religious ones)? At what point are you personally comfortable with making an assumption of truth (a faith leap) to create a foundation for your thought and beliefs? Can this be justified logically? Does it matter? Should it?
2. Identify and analyze your own thoughts about science and religion as you begin this course. What do you think their relationship has been? What is the source for your perceptions?

## Lecture Two

### The Warfare Thesis

**Scope:** In this lecture, we examine one formulation of the historical relationship between science and religion—the *warfare* or *conflict thesis*. Loudly advanced in the late 19<sup>th</sup> century by two men—John William Draper and Andrew Dickson White—it has continued strong in popular thought down to the present day. We will examine how this formulation rests on very shaky (and sometimes fabricated) foundations and was contrived largely for quite specific political, professional, and racist purposes. One value of this examination is to create a catalogue of methodological errors and fallacies for all readers of history to be on guard against. Serious modern historians of science have unanimously dismissed the warfare model as an adequate historical description.

### Outline

- I. The model for the interactions of science and religion most commonly encountered in popular literature and common belief is the *warfare* or *conflict thesis*.
  - A. The conflict or warfare thesis maintains that throughout history, religion and science have been opposed and inimical. Religion has stymied the advance of science.
  - B. No serious historians of science or of the science-religion issue today maintain the warfare thesis.
  - C. It is crucial to examine the origins of common beliefs, such as this one, and the solidity of their foundations.
    1. The origins of the warfare thesis lie in the late 19<sup>th</sup> century, specifically in the work of two men—John William Draper and Andrew Dickson White.
    2. These men had specific political purposes in mind when arguing their case, and the historical foundations of their work are unreliable.
- II. John William Draper (1811–1882), son of an English Methodist minister, was a chemist, physician, and first president of the American Chemical Society, who wrote *A History of the Conflict between Religion and Science* in 1874.
  - A. The book was commissioned by a popular science publisher for the International Scientific Series. It outsold every other title in this extensive series, went through 50 printings and 10 translations, and remains readily available.
  - B. The book is not good history; historical “facts” are confected, and causes and chronologies are twisted to the author’s purpose.
  - C. The text is actually one long, vitriolic, anti-Catholic diatribe.
    1. Draper blames the Catholic Church for almost everything bad in Western history (including preventing the “proper” expansion of the human population).
    2. Part of Draper’s ire results from the First Vatican Council’s then-recent declarations, particularly against abuses of rationalism, namely, the council’s assertion that there are revealed truths that are not accessible to unaided reason, that is, to rational (scientific) inquiry.
    3. Much of Draper’s text exemplifies the widespread Anglo-American anti-Catholicism and racism of the period—particularly opposition to new (Catholic) immigrants in America.
    4. At the same time, Protestantism is seen as the twin sister of modern science, and when Protestants cause problems, it is either on account of “misunderstandings” or because they are incompletely “emancipated” from Catholicism.
  - D. Although Draper’s work is easy to dismiss as cranky and ahistorical, his theme and many of his anecdotes have entered the common consciousness, where they have remained hard to remove.
- III. A more sustained, and seemingly more historical, presentation of the warfare thesis appeared in a series of publications by Andrew Dickson White.

- A. White first treated the subject in 1869, published a longer version (*The Warfare of Science*) in 1876, and eventually put out a ponderous two-volume work, *A History of the Warfare of Science with Theology in Christendom*, in 1896.
    - 1. White was a historian at the University of Michigan and, later, the first president of Cornell University.
    - 2. White's books, although still melodramatic in tone to modern tastes, did not share the rabidity of Draper and did not sell as well. But their apparent historical documentation gave them greater influence.
    - 3. White's interest was provoked by criticism he received for establishing Cornell without religious affiliation.
  - B. Despite appearances, White's arguments are scarcely better than Draper's.
    - 1. White uses fallacious arguments and suspect or bogus sources.
    - 2. His methodological errors are collectivism (the unwarrantable extension of an individual's views to represent that of some larger group of which he is a part), a lack of critical judgment about sources, argument by ridicule and assertion, failure to check primary sources, and quoting selectively and out of context.
    - 3. White popularized the baseless notions that before Columbus and Magellan, the world was thought to be flat and that the Earth's sphericity was officially opposed by the Church.
    - 4. He is also responsible for the equally fallacious notion that the Church forbade human dissection.
    - 5. The notion—eternally repopularized by Hollywood—that the medieval Church condemned all science as devilry runs throughout White; this view is likewise baseless.
- IV. These works are of interest in terms of their 19<sup>th</sup>-century context but have no general historical value for the science-religion issue.
- A. Besides poor scholarship, these books rely on a central and fallacious assumption: that scientists and theologians formed two separate camps throughout history and that theologians imposed their will on scientists.
    - 1. These categories are modern—rigorized only in the 19<sup>th</sup> century.
    - 2. The pre-modern thinkers retroactively called *scientists* themselves believed that theology and religious texts were relevant to their work and vice versa.
    - 3. Thus, religion was not an external imposition but a key part of the mental landscape of pre-modern natural philosophers.
    - 4. Divisions between science and religion that might seem familiar today are *not* transhistorical.
  - B. Despite the shoddy character of these publications, they were (and continue to be) widely influential. Their influence stems in part from their success in creating a *myth for science as a religion*, embraced ever since by science advocates.
  - C. The historian's task now is to analyze specific episodes contextually, to fill out a comprehensive view of issues and interactions, without recourse to “sound bite” oversimplifications.

**Essential Reading:**

David C. Lindberg and Ronald L. Numbers, eds., *God and Nature: Historical Essays on the Encounter between Christianity and Science*, Introduction.

Brooke, *Science and Religion*, pp. 33–51.

**Supplementary Reading:**

Lindberg and Numbers, “Beyond War and Peace.”



**Questions to Consider:**

1. Think about how erroneous notions in history arise and are passed down from generation to generation (for example, Columbus and a flat Earth, the constant warfare of science and religion, and so on). Is it possible to put these errors to rest? How would you go about it?
2. One possible excuse for Draper and White might be that the telling of history had a different purpose in the 19<sup>th</sup> century than now, namely, that it placed greater emphasis on instilling a “moral” than on being accurate. Critique this view and think about the “uses and abuses” of history then and now. What should we tolerate and not tolerate from historical treatments?

## Lecture Three

### Faith and Reason—Scripture and Nature

**Scope:** In this lecture, we confront some basic conceptual and philosophical issues in the science-religion question: What are the legitimate *means* of acquiring sure knowledge, and what are *sources* from which we can obtain such knowledge? The answers invoke faith and reason as the means and “God’s Two Books” (the Bible and the created world) as the sources. Here, we examine approaches to these means and sources in the Christian tradition, foundationally in St. Augustine’s 5<sup>th</sup>-century writings and more recently in the important 1998 encyclical *Fides et ratio*.

### Outline

- I. Faith and reason are two means of obtaining knowledge statements; two sources of knowledge statements are the traditional “Two Books”: the Book of Scripture and the Book of Nature.
- II. St. Augustine (354–430) produced a profound synthesis between Greek philosophical thought and Christian belief, thus creating theological systems and methods foundational to Christianity.
  - A. St. Augustine was born in North Africa to a Christian mother and pagan father. He rejected Christianity because its teachings seemed uncertain or illogical and the Bible seemed full of contradictions and nonsense.
  - B. After study of Classical philosophers and travel in Italy, Augustine found an intellectual approach to Christianity (through Neo-Platonism) and biblical exegesis that satisfied him, and he eventually was baptized.
  - C. St. Augustine made fundamental statements concerning our questions: the relationship of faith and reason and the correct methods of biblical interpretation.
    1. Reason and logical technique are necessary for theological inquiry. Augustine’s early objections to Christianity were against intellectually primitive forms.
    2. St. Augustine was following a scholarly tradition expressed by some earlier Christian writers, such as St. Clement of Alexandria.
- III. St. Augustine argued for four points that not only became fundamental to Christian theology but are key to the science-religion interaction.
  - A. First is the doctrine of the unity of truth.
    1. There is not one truth for theology and another for natural or philosophical knowledge.
    2. Therefore, we cannot sweep seeming contradictions under the rug; they must be resolved intellectually by the use of reason.
  - B. Second is the doctrine of the Two Books—the Book of Scripture and the Book of Nature.
    1. These are two complementary ways in which God reveals himself to man.
    2. Because both books have the same ultimate author, they cannot contradict one another.
  - C. Third is the recognition that both books require careful interpretation.
    1. St. Augustine wrote extensively about both the acquisition through the senses of natural knowledge and biblical interpretation.
    2. Biblical passages have layered meanings: for example, a literal, an allegorical, an anagogical, and a moral meaning.
    3. Literal interpretation did *not* mean what it does today; for example, St. Augustine’s *Literal Interpretation of Genesis* denies a six-day, and even a six-period, creation.
    4. The Bible’s ultimate divine authorship is partly obscured behind the human words expressed by human writers.
    5. Key to St. Augustine’s thought, then, is the doctrine of accommodation: Biblical expressions were accommodated to the understanding of their original audience.

6. Correct interpretation of either Scripture or the world requires the assiduous exercise of reason.
  7. Because biblical interpretation is very difficult, our explanations of some passages should be held only provisionally.
  8. Because it is often easier conclusively to prove natural and philosophical propositions than interpretations of specific biblical passages, our interpretations of biblical passages must be informed by the current state of sure scientific and other knowledge.
  9. Augustine’s writings are full of scientific information gleaned from reading Classical sources or his own observations.
  10. Failure to conform interpretations to the certain knowledge gained from other sources (such as the Book of Nature) opens the interpreter, and Christianity as a whole, to ridicule for being unlearned.
- D.** Fourth and finally, St. Augustine asserted that in terms of the pursuit of religion versus the pursuit of science or philosophy, religion has primacy, but scientific knowledge is a key *ancilla* (“handmaiden”) that assists true religion.
1. This subordinate status is a reflection of the relative values given by society at the time to the two realms of inquiry.
  2. Augustine stated that knowledge of the natural world both reveals the majesty of God’s creation and is indispensable for correct biblical exegesis.
- IV.** The complex relationship between knowledge gained by faith and knowledge gained by reason is summarized in two opposing phrases: *Credo ut intellegam* (“I believe so that I may understand”) and *Intellego ut credam* (“I understand so that I may believe.”).
- A.** The terms come from a well-known sermon by St. Augustine; this issue appeared frequently in his writings.
  - B.** Augustine concludes that the two are inseparable—they build on each other constantly. Neither can be slighted.
  - C.** Working together, they can be mutually correcting, helping us attain *recta ratio* and *recta fides*—right reason and right faith.
- V.** In 1998, Pope John Paul II issued an important encyclical entitled *Fides et ratio* (*Faith and Reason*), which deals precisely with the issues at hand.
- A.** The document sketches a useful history of the relationship of faith and reason in theology; its teachings reaffirm St. Augustine’s formulations.
    1. It emphasizes the indispensability of both faith and reason, which it calls the “two wings on which the human spirit rises to the contemplation of truth.”
    2. Faith held simply and without the exercise of reason is condemned and “runs the grave risk of withering into myth or superstition.”
    3. *Fideism* (blind faith over reason) and *biblicism* (reliance on biblical texts alone) are explicitly rejected.
  - B.** Likewise, unaided human reason is unable to attain or to prove the ultimate truths of existence; these are revealed through faith in the Christian revelation.
    1. The faith statements that run most strongly throughout the document are not specific dogmas of Christianity but, rather, that “human life has meaning” and that “there exists an eternal and transcendent truth.”
    2. These two faith statements are taken as propositions to guide the exercise of reason.
    3. Consequently, certain recent philosophical currents are criticized, including radical relativism, nihilism, and scientism.
    4. Specifically in terms of science, warning is given that scientific studies uninspired by a faith in greater meanings risk devolving solely into means of material production or of other abuses.
    5. The encyclical expresses an inherently optimistic view of humanity and human abilities, in opposition to recent pessimistic philosophical and cultural trends.

- C. In sum, like Augustine, the document sees the two ways of gaining knowledge as inextricably linked; both are necessary for the pursuit of, and the belief in, the existence of truth.

**Essential Reading:**

Lindberg and Numbers, *God and Nature*, chapter 1 (pp. 19–48).

John Paul II, *Fides et ratio*.

**Supplementary Reading:**

St. Augustine, *Confessions*.

**Questions to Consider:**

1. Two philosophical currents, scientism (all true knowledge is attainable through science) and skepticism (the foundations of our knowledge are slim or inadequate), both undercut the faith-based knowledge claims found in religious thought. What happens, however, when skepticism is applied to scientism? Does science hold up better against skepticism than theology?
2. Choose any premise you hold as true (a knowledge claim) and consider why you hold it as true (for example, on what grounds) and how firmly you do so. Consider the foundations of your premise and supporting premises. Is there a point at which a “leap of faith” is required to undergird your premise? Consider how “far back” in your personal knowledge system this leap is positioned. Do you remain confident (that is, trusting) of it? Why or why not? Repeat with other premises.

## Lecture Four

### God and Nature—Miracles and Demons

**Scope:** This lecture treats issues fundamental to the entire course, namely, the nature of causation and our ability to identify it accurately. A crucial point of contact between science and religion is the question of the extent of God's involvement in the running of the natural world. Theologians across time and denominations disagree widely on this point. Medieval theologians and natural philosophers, however, favored naturalistic explanations whenever possible, rather than recourse to divine intervention. The subject of miracles focused the issue, and the need to discern true miracles from superficially similar human, natural, or demonic marvels required scientific investigation of natural causes and, thus, instances a co-development of science and theology. Very importantly, one's views of the state of the spiritual world influence and form one's views toward the natural world and science.

### Outline

- I. The extent to which God is involved in the running of creation influences the role and importance assigned to natural science.
  - A. The fundamental question is that of causation; is it natural, supernatural, or both?
  - B. The Christian conception of a single, eternal, omnipotent God provides a necessary (though not sufficient) basis for science because it implies a regularity of action (that is, law-like behavior).
  - C. Theological conceptions of how active God is in the running of creation span a broad range.
    1. At one end lies supernaturalism, which holds that God is the immediate cause of all effects.
    2. Some supernaturalism can be called "naïve"; that is, God is resorted to as a general explanation of the unknown. God's activities need not be regular.
    3. Such supernaturalism undermines trust in scientific laws and the use of reason to comprehend the world because nature functions at God's direct whim.
    4. A more intellectually sophisticated form of supernaturalism is known as *occasionalism*. Occasionalism holds that all causation is directly from God's will and that the link we see between cause and effect is an artifact of our perceptions.
    5. Occasionalism need not undermine science, because God is rarely conceived of as capricious. His constancy—a kind of a covenant with his creation—fills in for "laws of nature." Occasionalists see these laws as artifacts of God's uniform behavior.
    6. God thus maintains, by the continuous exercise of his uniform activity, a *cursus communis naturae* ("common course of nature").
    7. At the other end of the spectrum is *naturalism*, which holds that God's direct activity ceased after the creation—effects (and the *cursus communis naturae*) are caused by powers, laws, or "natures" that God initially implanted in things.
    8. The two views are based on notions of primary and secondary causation. God is the primary cause; created things are secondary causes.
    9. In fact, we cannot ascertain empirically the true nature of causation (that is, decide between naturalism and supernaturalism).
    10. Both have been subject to criticism on logical grounds, and between these extremes exists a continuum of intermediate positions.
  - D. In general, traditional Christianity (particularly in the Middle Ages) holds a position on the naturalism side but not radically so.
    1. Thirteenth-century theologians argued that although God can do anything he wishes, he chooses to restrict himself (almost always) within the *communis cursus naturae*, thus guaranteeing the validity of logical investigation in an (almost always) constant world.
    2. This state of affairs runs contrary to much popular opinion, which erroneously believes that medievals had frequent recourse to supernatural activity for explanations.

3. Given the bent toward naturalism, orthodox Christian theology holds that God *almost* invariably works through “secondary causes.”
  4. Expositions of the creation of the world in the Middle Ages were often highly naturalistic; God’s direct activity was, for some theologians, limited to an initial moment of *creatio ex nihilo*.
  5. Some medievals (for example, the School of Chartres) also proposed naturalism to explain some biblical miracles, such as the parting of the Red Sea.
  6. This choice of view guarantees an important place for scientific investigation of causes.
- II. Miracles provide a crucial test case for views on God’s activity in nature.**
- A. Although medieval thinkers favored naturalism, room had to be left for at least some miracles (for example, the Resurrection) affirmed by faith.
  - B. For most Christian theologian/natural philosophers, miracles somehow fall outside the *cursus communis naturae*.
  - C. The key problem lies in the discernment of miracles (how do we recognize a true miracle?) because: (a) a given phenomenon may have diverse causes, and (b) we may not recognize an apparently natural event as actually miraculous.
    1. We can recognize a miracle only if we know natural causes extremely well; thus, a desire to verify miracles leads to scientific inquiry.
    2. Miracles can show a naturally inexplicable disproportion between cause and effect; thus, the power of natural causes must be known.
    3. Advances in scientific understanding, by teaching us the limit of natural actions, bear upon the discernment of miracles.
    4. This is one example of the co-development of science and religion.
- III. Protestants (especially Anglicans) invented the doctrine of the cessation of miracles—that the “age of miracles” ceased with the apostolic generation.**
- A. This doctrine was promulgated largely to discredit Catholicism, which held that miracles not only continued to occur but continued to testify to truth of the Catholic faith.
  - B. Shorn of the evidential power of miracles, some Protestant thinkers of the 17<sup>th</sup> century—including well-known natural philosophers—turned to the investigation of witch and demon activity in order to gather evidence of the spirit realm (see Lecture Seven).
  - C. Demonic activity was already of great interest to theologians and natural philosophers.
    1. Demons cannot perform miracles but only trick us into thinking that they can.
    2. In orthodox Christian theology, demons do *not* have supernatural power (contrary to modern popular opinion).
    3. They do, however, know natural laws perfectly, and being incorporeal, they can move with infinite speed. Thus, they *appear* to work miracles, but their actions are natural.
    4. A very learned human being could do nearly as well as demons; hence, the power of technology to produce *marvels* but not *miracles*.
- IV. Some recent forms of Christianity exemplify the link among views of God’s activity in the world, miracles, and trust in scientific inquiry.**
- A. Some non-mainstream American fundamentalist sects greatly enhance the frequency and importance of “miracles” (a kind of crude occasionalism) and, consequently, diminish natural causation and the scope of scientific frameworks.
  - B. Further, they attribute far greater power to Satan and demonic forces than is orthodox and, thus, border on (or even fall into) Manichean dualism.
    1. Consequently, their spiritual world is disordered, reflected in an irregular natural world (full of interventions) and a lack of faith in the regularities that constitute science.

2. It is not surprising that these same sects are those that most consistently oppose scientific inquiry, explanation, and education.

**Essential Reading:**

Lindberg and Numbers, *God and Nature*, chapter 2 (pp. 49–75).

**Supplementary Reading:**

Amos Funkenstein, *Theology and the Scientific Imagination*.

**Questions to Consider:**

1. How would the status of miracles differ in a supernaturalist versus a theistic naturalist view of the world? Think about how the *cursus communis naturae* is generated in each.
2. Imagine that God suspended all his activity for an indeterminate (but finite) period of time; how would this appear to us? Assume first that naturalism is the correct description of the world; then assume an occasionalist (supernaturalist) perspective. Could the suspension of God's activity for a time help us decide between naturalism and supernaturalism? (Hint: Think about how we sense.)

## Lecture Five

### Church, Copernicus, and Galileo

**Scope:** The “Galileo affair” is undoubtedly the most often-cited incident in the history of science-religion interactions. Far from being a simple case of science versus religion, however, it is extremely complex and brings up a host of important philosophical, scientific, and other issues that must be understood in context. In this lecture, we look at the background to these events in Copernicus’s heliocentric theory, then detail the intricate events of 1613–1616—“Act I” of the Galileo affair—and their implications and possible explanations.

#### Outline

- I. The “Galileo affair” is undoubtedly the most often-cited incident in the history of science-religion interactions.
  - A. Although often presented as a simple “conflict” of religion against science, it is actually extremely complex, involving intellectual, philosophical, political, social, and personal clashes that far transcend in scope, interest, and importance any simplistic (and usually propagandistic) science-versus-religion readings.
  - B. We will address three historical events in this and the following lecture:
    1. The background in terms of the proposal of Copernicus’s heliocentric-geokinetic theory.
    2. The first phase of the Galileo affair (1613–1616) and its implications.
    3. The second phase of the Galileo affair (1632–1633), which ended in Galileo’s conviction, recantation, and house arrest, and its implications.
- II. In 1543, Nicholas Copernicus published his *De revolutionibus orbium coelestium*, which argued that, contrary to the prevailing Ptolemaic-Aristotelian system, the Sun was at the center of the universe (heliocentrism) and the Earth revolved around it (geokineticism).
  - A. Copernicus delayed publication but was urged into publishing by several churchmen.
    1. He dedicated the work to Pope Paul III.
    2. Copernicus was himself in Holy Orders (a canon), and his astronomical expertise was sought out by Church officials to help reform the calendar.
  - B. Copernicus’s theory found little acceptance.
    1. It violated commonsense experience and 2,000 years of astronomical theory and subverted fundamental principles of physics.
    2. No observational data supported it; predicted phenomena from a moving Earth (parallax) could not be observed.
    3. More literal readers of Scripture found it contradictory of clear passages, such as Joshua’s miracle of making the *Sun* (not the Earth) stand still.
- III. The first phase of the Galileo affair occurred in 1613–1616.
  - A. In 1613, Galileo’s student Fr. Benedetto Castelli was asked by the Grand Duchess Christina (mother of Galileo’s patron) about conflicts between Galileo’s geokinetic theory and the Bible.
    1. The key biblical passage is the story of Joshua stopping the Sun to lengthen the day; other passages imply a stationary Earth and moving Sun.
    2. Castelli told Galileo about the event, and Galileo replied with a letter describing his position; Galileo eventually wrote a much longer letter to Christina.
    3. Galileo argued that Scripture had to be interpreted in the light of scientific knowledge; its expressions were accommodated to the original audience; and the literal meaning could be saved thanks to his own discovery of the Sun’s rotation, which, he suggested, powered the planets.



- B. On 20 December 1614, the Dominican friar Tommaso Caccini preached a sermon at Santa Maria Novella in Florence; he expounded the Joshua passage, then criticized Copernicus, mathematicians, and Galileo’s followers.
- C. The Inquisition was pulled in a few months later when another Florentine Dominican, Niccolò Lorini (who had attacked Galileo two years earlier), wrote a letter of complaint to the head of the Index and forwarded a copy of Galileo’s letter to Castelli.
  - 1. Galileo’s letter was found to have some “bad expressions” but no serious objections. Two of the three “bad expressions” exist only in Lorini’s copy, not in Galileo’s original, suggesting that someone (Lorini?) was trying to make Galileo look bad.
  - 2. Caccini was questioned; he claimed that Galileo’s disciples held (seriously) heretical beliefs.
  - 3. Persons named by Caccini were questioned, and Caccini’s serious accusations were found groundless.
  - 4. But the Inquisition convened a panel of consultants to examine the geokinetic thesis. On 24 February 1616, the panel advised that Copernicanism was “foolish and absurd” in philosophy and “heretical” in theology.
  - 5. The Inquisition took no action on the recommendation.
  - 6. However, the Index suspended circulation of Copernicus’s book “until corrected.” These “corrections” involved deleting passages offering interpretations of Scripture and claiming Copernicanism to be literally true.
  - 7. Cardinal Roberto Bellarmino, one of the most powerful churchmen of the day in Rome and a highly important theologian, was told to give Galileo a verbal warning not to continue to hold Copernicanism as literally true. Galileo agreed.
- D. Understanding this result requires some further background, especially regarding Bellarmino.
  - 1. In early 1615, a Neapolitan priest named Paolo Antonio Foscarini published a book reinterpreting the Bible to be compatible with Copernicanism.
  - 2. He sent a copy to Bellarmino; his reply is crucial background to the Galileo affair.
  - 3. Bellarmino praised Foscarini (and Galileo) for speaking “suppositionally and not absolutely,” because declaring the absolute truth of the hypothesis would be “dangerous.”
  - 4. However, he also claimed that *if* there were an undeniable demonstration of the Earth’s motion, then Scripture would have to be reinterpreted carefully.
  - 5. Galileo, who had gone to Rome and who knew Bellarmino personally, apparently got a copy of Bellarmino’s letter and wrote a rebuttal.
  - 6. When the Index suspended Copernicus’s book, it condemned Foscarini’s.

#### IV. Examination of this first phase reveals a wealth of issues to be considered.

- A. Biblical interpretation seems to be a key issue, but even this is not straightforward.
  - 1. Galileo’s writings show an exemplary understanding of accepted (Augustinian) principles of biblical exegesis.
  - 2. Earlier authors had reinterpreted the same passages without incident; thus, there is something special about Galileo and his time.
  - 3. To stave off further schism in the aftermath of the Reformation (which emphasized “personal interpretations” of Scripture), the Council of Trent (where Bellarmino was a key figure) forbade the reinterpretation of Scripture “contrary to the consensus” of the patristic writers.
  - 4. The fact that Foscarini published similar material at the same time may have aggravated the case.
  - 5. Galileo (and Foscarini) violated “intellectual turf” by claiming that his biblical interpretations were superior to those of theologians, especially while he told theologians to stay out of natural philosophy.
- B. Bellarmino conceded that a sound demonstration of the Earth’s motion would lead to reinterpretation, but Galileo had no such proof.
  - 1. Galileo’s telescopic “proofs”—the Jovian satellites and the phases of Venus—are inconclusive.
  - 2. Galileo’s favored “proof”—that the tides are caused by the motion of the Earth—is completely wrong.
  - 3. Although Galileo was ultimately correct about heliocentrism, he was wrong to claim he had proof of it.

- 4. Confusion would result if the Scriptures had to be reinterpreted for every *possible* (unproven) scientific system.
  - C. Galileo might also have been caught in a power struggle between rival intellectual elites—Dominicans and Jesuits. Galileo’s accusers were all Dominicans, and Galileo was on good terms with the Jesuits, who had verified his telescopic observations.
  - D. We are not free to indulge in collectivism by extending the actions of specific churchmen into a generalized statement about Galileo versus “the Church” (much less about science versus religion); there were clergy, theologians, and officials *on both sides* of the issue.
  - E. Finally, we have also to consider the larger issue of the nature of scientific knowledge (see Lecture Six).
- V. After everything had been settled, final developments set the stage for developments 15 years later.
- A. Galileo asked for an audience with the pope. The pope acknowledged that Galileo had certain enemies but stated that both he and the cardinals thought well of him and that Galileo could “feel safe as long” as the pope lived.
  - B. Galileo heard that rumors about his having been “condemned” were circulating and asked Bellarmino for a certificate setting out exactly what had been done.

**Essential Reading:**

Maurice A. Finocchiaro, *The Galileo Affair*, pp. 1–69, 87–118, 134–153.

**Supplementary Reading:**

Finocchiaro, *The Galileo Affair*, pp. 70–86.

Lindberg and Numbers, *God and Nature*, chapter 3 (pp. 76–113).

**Questions to Consider:**

1. Much of the first part of the Galileo affair deals with the issue of personal interpretations of Scripture. Consider the issue of personal interpretations. If theology is intended to give us objectively true knowledge, should personal interpretations of the Book of Scripture (resulting in theological knowledge) be handled or considered any differently from personal interpretations of the Book of Nature (resulting in scientific knowledge)?
2. In his “Letter to Christina,” to what extent does Galileo mark out an intellectual sphere for natural philosophers in which he considers theologians are not permitted to tread? Given that the role and distinctness of the natural philosopher were not clear at this time, how would Galileo’s thoughts be viewed? What would be the results of taking his advice?

## Lecture Six

### Galileo's Trial

**Scope:** After more than 15 years of calm, Galileo got into trouble in 1632–1633 because of his book *Dialogue on the Two Chief World Systems*. In the end, he abjured the motion of the Earth as a false doctrine and spent the rest of his life under house arrest. This lecture examines this latter phase of the Galileo affair, presents explanations of the events, and looks at how these events have been used, abused, and reexamined down to the present day. Of particular importance are the arguments made on both sides about the relative intellectual roles of science and faith and the levels of certainty we can have about each.

### Outline

- I. In 1623, Galileo's friend and admirer Maffeo Barberini was elected Pope Urban VIII.
  - A. Galileo soon thereafter published *Il Saggiatore*, dedicating it to the new pope. Some charges were made against the book regarding its implications for the Eucharist, but the Inquisition dismissed these as groundless.
  - B. In early 1624, Galileo went to Rome and met with the pope; he was warmly received.
    1. They discussed the Earth's motion, and the pope said that Galileo could write about it, provided that he included one particular epistemological argument.
    2. This argument was Urban VIII's contention that because God is omnipotent, the determination of ultimate causes can never be absolutely certain; that is, a given phenomenon could have various causes.
    3. The pope was later heard to say that the Index's decree should have been prevented.
  - C. Galileo set to work, first writing a (sarcastic) reply to Francesco Ingoli, who had written against the Earth's motion in 1616.
  - D. He then began a dialogue, first entitled *On the Tides* but later called *A Dialogue on the Two Chief World Systems*.
    1. The events surrounding its publication were tortuous.
    2. In 1630, Galileo went to Rome to print the book; he received approval from Niccolò Riccardi, Vatican secretary and chief censor.
    3. Problems (death, plague, and delays) intervened, and Galileo moved to publish the work in Florence. The secretary sent a list of alterations and transferred authority to publish to Florence.
    4. The book was finally published in 1632.
- II. Although the book was widely praised, questions and rumors arose at Rome, initiating the final phase of the Galileo affair.
  - A. Pope Urban VIII was furious with Galileo: "I have been deceived!"
    1. Galileo put the pope's argument only on the last page of the book and into the mouth of a fool.
    2. The pope learned for the first time of Galileo's 1616 agreement with Bellarmino—something Galileo "forgot to mention."
  - B. In terms of "external factors," the pope was under duress at this time owing to the Thirty Years' War, which he refused to support. His secretary, who continued to voice his support of Galileo to the pope, also supported the Spanish party that was trying to depose Urban.
  - C. Galileo was summoned to Rome and questioned.
    1. The Inquisitors produced a document from 1616, in which Galileo agreed not to discuss Copernicanism.
    2. Galileo was surprised by the document, which did not bear his signature. He presented Bellarmino's certificate, which in turn, surprised the Inquisitors.
  - D. The legal case was very specific—it was not about heliocentrism—rather, did Galileo violate the terms of his 1616 agreement with Bellarmino?

1. Galileo argued that he didn't really believe heliocentrism was true but was just playing around to make a weak argument look strong.
  2. A lenient "plea bargain" was reached.
  3. But Pope Urban VIII dismissed the bargain and ordered a formal trial; Galileo was convicted in June 1633 of "vehement suspicion of heresy," and he abjured the Earth's motion.
- E. Francesco Barberini, the pope's nephew, did not sign the conviction—nor did two other cardinals—a possible signal that it was, in part, the result of a "show trial."

**III. Significant philosophical issues were involved throughout the case.**

- A. A key issue is the split between realist and instrumentalist views of science.
- B. Realism holds that scientific theories are *true* depictions of the world.
- C. Instrumentalism holds that scientific theories are simply *tools* for providing plausible explanations and for "saving the phenomena."
- D. Superimposed on the Galileo affair was a contemporaneous shift in astronomy from instrumentalism to realism.
- E. Copernicus, Kepler, Galileo (and most modern scientists) are realists; Bellarmino, Urban VIII, the Collegio Romano, and probably most practicing astronomers of the day were instrumentalists.
- F. Copernicus's book likewise shows this tension in the unsigned preface added to it (without Copernicus's knowledge) by the Lutheran minister Andreas Osiander.
- G. The realist position—although characteristic of modern science—is ultimately a choice and a faith statement (one that facilitates modern research).

**IV. In 1979, Pope John Paul II convened a commission to reinvestigate Galileo's case. Besides an admission of "errors committed," the report contained a reaffirmation of Augustinian principles of exegesis (as upheld by Galileo) and the ultimate compatibility of faith and reason.**

**Essential Reading:**

Finocchiaro, *The Galileo Affair*, pp. 200–202 (correction to Copernicus), 204–226, 227–293.

**Supplementary Reading:**

Finocchiaro, *The Galileo Affair*, pp. 154–197.

Lindberg and Numbers, *God and Nature*, chapter 3 (pp. 76–113).

**Questions to Consider:**

1. If you were Galileo, how might you have handled things differently? What if you were Bellarmino or Urban VIII?
2. The philosophical and intellectual differences between Galileo and Urban VIII center on human abilities to acquire sure knowledge of causation (remember Lecture Four?). Can you suggest any rational method for resolving the difference between them? Any pragmatic method?

## Lecture Seven

### God the Watchmaker

**Scope:** The 17<sup>th</sup>-century introduction of the idea of a mechanical universe functioning like a great clockwork implied the creative actions of a divine mechanist but simultaneously distanced him from creation and could even make him seem unnecessary. Natural philosophers had to deal with this crisis, and their deep-seated fears over the new growth of irreligion and atheism provided a new context. This lecture surveys the problem and some of the means used to address it by Robert Boyle, Isaac Newton, and others, as well as the concomitant creation of a new problem: the “God of the gaps”—an unsatisfactory image of the deity wherein he is invoked as a cause for any problem for which science has no explanation, a sort of a scientific *deus ex machina*.

### Outline

- I. In the 17<sup>th</sup> century, a new conception of the natural world and its functioning was developed; it was called the *mechanical philosophy*.
  - A. The mechanical philosophy conceived of the world as a great machine functioning mechanically; matter (generally composed of minute particles), its shape, and its motion explained all natural phenomena.
  - B. This philosophy was proposed as a replacement to the Aristotelian natural philosophical system.
  - C. Yet it also drew on notions of a *machina mundi* (“world machine”) that had been developing since the Middle Ages.
  - D. Some major proponents of this system were the priest Pierre Gassendi, René Descartes, Robert Boyle, and many others.
- II. The theological impact of the mechanical philosophy was mixed.
  - A. Gassendi, although he revived ancient atomism, insisted that the atoms were created and given their motion by God.
  - B. The Minim priest Marin Mersenne seems to have advocated a mechanical system in order to buttress the doctrine of miracles and their discernibility.
  - C. The concept of the world as a machine or clockwork implied the existence of a divine craftsman; thus, it could be viewed as a support of religion. However, the *kind* of God it suggested was not necessarily orthodox; for example, it could suggest an “absentee God.”
  - D. The mechanical philosophy also ran the risk of promoting materialism—the belief that matter is all there is (no spiritual entities).
    1. Concern over materialism continues to characterize intellectual theological responses down to the present.
    2. Materialism further invokes the danger of determinism—without entities external to matter and able to interact with it, then the motions of particles determine all future events, and there can be no free will.
    3. Materialism also almost unavoidably leads to atheism (“no spirits—no God”).
    4. Fear of atheism was common in the late 17<sup>th</sup> century—this was, at the time, a new concern, but it has characterized religious (especially Protestant) apologetics and fears ever since.
- III. Numerous responses to the mechanical philosophy were proposed to address its potential toward materialism, atheism, and other theologically unacceptable ideas.
  - A. Some thinkers, such as the Cambridge Platonists (including Henry More), argued that brute matter and motion were simply insufficient; they posited non-sentient, non-corporeal entities (the “spirit of nature” and the “plastic principle”) to guide natural processes.
  - B. Robert Boyle (1627–1691) rejected this notion of the Cambridge Platonists, believing such entities to be unnecessary intermediaries between God and his creation.
    1. Boyle was deeply religious and viewed the role of the natural philosopher (“scientist”) as a “priest of nature.”

2. This view of the study of the natural world as an inherently religious, devotional activity was common—it is linked to the concept of the Two Books.
  3. Boyle believed that God’s activity was necessary to uphold the “common course of nature,” because brute bodies cannot, of themselves, obey laws.
  4. He attempted to defuse atheism and materialism by seeking authentic instances of spirit activity—in witchcraft and apparitions.
  5. This was a widespread project in late-17<sup>th</sup>-century England, resulting partly from the loss of ecclesiastical recognition of miracles and, thus, of divine activity.
  6. Boyle even brought his interest in alchemy (meaning the transmutation of metals into gold) in to help, because he believed that the philosophers’ stone might be able to attract angels and facilitate communication with them.
  7. What is key to recognize is that the investigation of spiritual phenomena was carried out by prominent natural philosophers; such studies could be as much a part of their investigations as chemistry or physics. This is no longer the case.
- IV. One characteristic of the science-religion landscape of the 17<sup>th</sup> century was the conviction that scientific discoveries would provide the best support for religious belief.
- A. The early Boyle Lectures—a series of lectures to combat atheism that began in 1692 and were funded in Boyle’s will—offer revealing instances of this strategy.
  - B. The first Boyle lecturer was Richard Bentley (1662–1742); in eight lectures given in 1692, he used recent scientific discoveries to argue against atheism.
  - C. Much of the specific material Bentley used came from Sir Isaac Newton (1642–1727).
    1. Newton himself was deeply religious, as is the case (we must remember) for essentially *all* of the “scientific greats” of the early modern period.
    2. Newton’s beliefs were, in fact, heretical, and he spent much time trying to identify and correct what he thought were “corruptions” in Scripture.
    3. Newton’s *Principia mathematica* (1687), a foundational text of classical physics, freely discusses the attributes and activities of God.
    4. It was not unusual for physics texts of the time to deal with topics we today would consider “religious” and, thus, inappropriate for inclusion; this is evidence of the fluid (and culturally contingent) boundaries between science and religion over time.
    5. Like many of his English contemporaries, Newton wanted to identify evidence of divine activity in the world; he may have believed gravity to be such activity.
  - D. Bentley’s arguments use the structure of the Solar System as evidence of divine design and its continued stability as evidence of God’s providence and continued activity.
  - E. But such arguments are problematic because they are an appeal to ignorance; they create an ultimately unsuitable “God of the gaps.”
    1. The phrase *God of the gaps* refers to an image of the deity (inadvertently) created by arguments that invoke his direct intercession to explain otherwise inexplicable phenomena or situations, that is, to “close the gaps” in otherwise naturalistic explanations.
    2. But such gaps tend to close with the advance of scientific knowledge, thus putting religion in the position of constant retreat.
    3. This is one background to the common belief (expressed by White) that religion always retreats before science. But such “retreat” is historically contingent—it depends on the choice to create and to rely on God-of-the-gaps arguments.
    4. It is possible that some gaps cannot be closed, but historically speaking, these are few in comparison to the many proposed since the 17<sup>th</sup> century.
  - F. The use of knowledge of the natural world to support religious belief developed extensively in the 18<sup>th</sup> and 19<sup>th</sup> centuries; it became known as *natural theology*.

**Essential Reading:**

Lindberg and Numbers, *God and Nature*, chapters 5–6 (pp. 136–192).

**Supplementary Reading:**

Lawrence M. Principe, *Aspiring Adept*, pp. 190–212 (on Boyle, alchemy, and angels).

**Questions to Consider:**

1. Analyze the problems (for Christianity) with the concept of an absentee God and of a God of the gaps. Are these similar sorts of problems? How are they the same and how are they different? To what larger concerns do the concerns over these conceptions of the deity relate?
2. What would be the reception today of a physics text that treated the immortality of the soul and God's attributes? Why were things different for Newton and Boyle? Would the modern reception be markedly different if the text adopted an explicitly theistic or an explicitly atheistic position? How defensible would the modern response be? On what grounds?

## Lecture Eight

### Natural Theology and Arguments from Design

**Scope:** The world is full of wondrous things that evoke our admiration. Some authors, accordingly, have used the natural world to argue for the existence of the deity. Indeed, for centuries, the study of the natural world was seen as, in part, a devotional act. This lecture examines the emergence and content of *natural theology*, especially in England in the 18<sup>th</sup> and 19<sup>th</sup> centuries, and the important shift it witnesses from a personally devotional aspect of science into an expressly apologetic one. Recently, *intelligent design* (ID) has appeared as a further step in the track of natural theology. This lecture looks at historical features of both approaches and their limitations.

#### Outline

- I. The drawing of inferences and proofs about the deity from the natural world is known as *natural theology*.
  - A. Although limited theological readings of the “book of nature” have been carried out since antiquity, a developed natural theology arose only in the 17<sup>th</sup> and 18<sup>th</sup> centuries.
    1. Natural theology proved highly influential, diverse, and resilient down to the 19<sup>th</sup> century; it was especially prominent in the anglophonic world.
    2. *The Wisdom of God Manifested in the Works of Creation* (1691) by John Ray (1628–1705) is a foundational text in the genre.
    3. Many early Boyle Lectures featured natural theology, for example, Richard Bentley’s 1692 sermons and the 1711 and 1712 lectures of William Durham (on physico-theology).
    4. Perhaps the most cited example is that of William Paley (1743–1805), whose 1802 *Natural Theology, or Evidences of the Existence and Attributes of the Deity Collected from the Appearances of Nature* proved enormously popular.
  - B. Both natural philosophers (“scientists”) and clergymen wrote works on natural theology; indeed, natural theology was a meeting ground of science and religion. The *Bridgewater Treatises* (1830s) were a comprehensive collection of natural theology gleaned from various sciences and mathematics, written by some of England’s leading scientific thinkers, and funded by the 8<sup>th</sup> Earl of Bridgewater.
  - C. Much early natural theology sprang from 17<sup>th</sup>-century mechanical conceptions of the world—a watch implies a watchmaker.
  - D. Although some, including Paley, argued that attributes of God (mercy, unity, providence, and so on) could be drawn from nature, the brunt of natural theology was to prove simply God’s existence.
    1. Thus, the argument from design was central to natural theology.
    2. The argument from design holds that the smooth functioning and intricate contrivance of the universe implies a designer, that is, provides proof for the existence of God.
- II. The argument from design was prone to criticism; upon analysis, it turned out to be weak, ambiguous, and—from the point of view of orthodox Christianity—dangerous.
  - A. Natural theological arguments can result in many different kinds of a God.
    1. A watch may imply a master watchmaker, but it can also imply a company of watchmakers (that is, polytheism) or an apprentice watchmaker (a demiurge).
    2. The God of natural theology (like the “God of the philosophers”) is far from the Christian God—without moral force, unique eternity, personal concern, or other attributes.
    3. Indeed, deists latched onto natural theology as much as Anglican vicars.
    4. Analogical reasoning is valid only if the analogical basis is sound—the basis on which the design argument rests is that God is like a human being. This is a dangerous anthropomorphism.
  - B. Pressed too forcefully, such arguments actually encourage non-Christian views of God by overemphasizing rational arguments for his mere *existence* at the expense of faith in the revelations of his *attributes*.
  - C. The probatory power of the argument from design is very weak.



1. We cannot tell whether perceived design is real or an illusion; there is no possibility of comparing a designed versus an undesigned universe. There is no valid yardstick with which to measure degrees of design.
  2. The argument often relies on an appeal to ignorance; we “cannot imagine” how an intricate system could come to be without an intelligent designer.
  3. Thus, the argument from design can appeal only to *emotion* (feelings of awe and wonder), rather than to *reason*.
  4. Although possibly exhortatory in a devotional context, the design argument is unsatisfactory in a rigorously probatory (for example, scientific) one.
- D. The last point highlights a crucial historical development within natural theology—namely, a shift in focus from awe at the natural world in heightening devotion in believers to its use as an apologetic to convince nonbelievers.
1. Design is in the eye of the beholder.
  2. The propagation and popularity of the design argument stems from historical, political, social, and geographical circumstances of 18<sup>th</sup>-century England.
  3. Thus, the development of and reliance on such arguments makes sense only in a cultural context in which there is paranoia about atheism.
- E. The ubiquity of natural theology and its argument from design is the necessary background to Darwin and his reception.
- III. A recent redevelopment of the argument from design has appeared in the United States: *intelligent design* (ID).
- A. ID holds two basic tenets:
1. Intelligent causes have a crucial role in the origin and design of the universe and of life and its diversity.
  2. Design is empirically detectable in nature.
- B. Many (but not all) supporters present ID as scientific, yet critics identify it as a thinly veiled offensive by evangelical/fundamentalist Christians to insert particular belief systems into scientific and educational establishments.
1. The fact that ID is argued for primarily in the courts of law and public opinion (rather than in appropriate scientific organs) would seem to support this contention.
  2. For the most vocal supporters, there is a clear political and social agenda.
  3. The existence of such agendas is not necessarily damning, because historically, some scientific positions have similarly embraced political or social agendas. But it *is* a crucial part of the context.
- C. Insofar as ID is akin to natural theology (that is, deploying the argument from design), it is susceptible to all the critiques, weaknesses, and problems of natural theology.
- D. Some ID proponents differentiate their position from natural theology by claiming that ID is not about proving the *existence* of a designer but, rather, exploring what the *assumption* of a designer can explain.
1. In this formulation, however, it is hard to imagine what explanatory improvements could be forthcoming.
  2. ID begins with features of the world that are, in the words of one ID proponent, “inherently inexplicable in terms of natural causes.”
  3. The claim of “inherent inexplicability” is problematic and asserts that ordinary secondary causation is inadequate; thus, primary causation—the action of a designer—must be invoked.
  4. But primary causation is, by its very nature, incomprehensible to us—like a *creatio ex nihilo*.
  5. Thus, recourse to primary causation explains nothing in the usual sense of the word *explain*.
  6. When we rule out the usual functioning of natural causes, we are left with only two options: (a) direct primary causation (for example, the creation out of nothing); (b) the First Cause acts through secondary causes in such a way that their usual action is altered, for example, when an effect is disproportionate—a miracle.
  7. But all we can do with such an event is to label it as such, not explain it. (If we could explain it, it would not be a miracle.)
  8. The promise, therefore, that the designer might literally *explain* something is vain.

9. Human beings can comprehend only secondary causation; recourse to primary causation is an abandonment of the search for explanation and understanding. This is how medieval theologians gravitated toward the position of naturalism.
- E. Methodologically favoring naturalism is a way to preserve what is the most fundamental human aspiration—the search for understanding. This applies with equal force to both science and theology.
- F. Naturalism is a favorite whipping boy for ID supporters, but they conflate two different kinds of naturalism.
  1. Methodological naturalism says only that we should appeal solely to natural causes when giving explanations of natural things.
  2. But philosophical naturalism says that the natural is all that exists.
  3. Philosophical naturalism entails atheism; methodological naturalism does not.
- G. ID supporters depict the scientific community as inherently atheistic and atheism as a “non-scientifically” assumed position.
  1. Considered free from context, starting positions of theism and atheism are equally faith-based (non-rational) assumptions.
  2. But in specifically scientific studies, naturalism has been a guiding *methodological principle*, favored by natural philosophers and theologians since antiquity; such naturalism need *not* imply atheism.
  3. ID’s depictions of scientists are straw-man arguments; more than 40 percent of current American scientists believe in a personal God and a larger percentage (a majority), in a transcendent being.
- H. We will treat ID further in the lecture on evolution, which is a central point of concern for most ID proponents.

**Essential Reading:**

Brooke, *Science and Religion*, chapter 6 (pp. 192–225).

William A. Dembski, “Is Intelligent Design a Form of Natural Theology?”

**Supplementary Reading:**

Eugenie Scott, *Creationism vs. Evolution: An Introduction*.

**Questions to Consider:**

1. Given that it has no power actually to explain anything any better than simply saying that the thing is inexplicable, what could be the point behind the promotion of ID?
2. What might be the causes for the “watering down” of rational and speculative medieval theology into English natural theology of the 18<sup>th</sup> and 19<sup>th</sup> centuries?

## Lecture Nine

### Geology, Cosmology, and Biblical Chronology

**Scope:** How old is the Earth and the universe? One can count backwards through the biblical begets to get a figure, but late-18<sup>th</sup>-century geology began to reveal a vastly older Earth. This lecture looks at attempts to date the Earth, the hints that it is vastly older than the Bible implies, and the responses from religious figures to this redating. Similarly, cosmogonic (origin of the universe) speculation has involved both scientific and theological minds equally over time. Significantly, the historical “battle lines” between rival interpretations of both the Earth’s and the universe’s ages and origins do not map out on simple religion/science lines but, instead, reveal a more complex picture rooted largely in social and professional differences.

### Outline

- I. The ages and origins of the Earth and the universe are important topics for both science and religion.
  - A. In the Middle Ages, there was little reason to think that the Earth and universe were older than a few thousand years.
    1. The Bible was one of the oldest texts known, and there was no alternative evidence to contradict (or significantly supplement) its Old Testament chronology.
    2. In a homocentric universe, there would be no point to an Earth much older than man.
  - B. Renaissance humanists, such as J. J. Scaliger, compiled chronologies using both biblical and other written sources.
- II. In the 17<sup>th</sup> century, new scientific theories were grafted onto these earlier narratives.
  - A. Fossils and geological strata gained attention and importance in the 17<sup>th</sup> century, although their meaning was ambiguous.
    1. Nicholas Steno (a Danish convert to Catholicism and now a *beatus*) studied strata and fossils in Tuscany and developed geological theories for their formation.
    2. He argued four important points: (a) Fossils are the remains of living creatures; (b) rock strata are sedimentary deposits; (c) because the strata are sediments, they must have been laid down horizontally; thus, wherever we see them at an angle, they must have been shifted at some time subsequent to their formation; and (d) the lower strata must be older than the higher strata.
    3. Steno was one of the first to view the surface of the Earth as a historical record.
  - B. At the end of the 17<sup>th</sup> century, there were attempts to intertwine biblical and geological histories into theories of the Earth.
    1. One of these attempts was Thomas Burnet’s *Sacred Theory of the Earth*, in which he posited six geological ages that were punctuated by cataclysmic biblical events. An example is his claim that the world, as originally formed, had a smooth surface, but at some point, it cracked and collapsed, releasing subterranean waters recorded in Scripture as Noah’s Flood.
    2. In 1694, the astronomer Edmund Halley critiqued Burnet’s theory. Halley suggested that collision with a comet knocked the Earth’s axis off vertical, causing geological devastation and Noah’s Flood.
    3. In 1695, John Woodward argued that the specificity of fossils to particular strata was the result of settling out from Noah’s Flood.
  - C. The Flood thus became a *geological* event, not just a biblico-historical event, and was tied in to natural theology.
- III. New naturalistic theories for origins of the Earth were proposed in the 18<sup>th</sup> century by Buffon and Laplace.
  - A. These progressively increased the age of the Earth, particularly the pre-human period.
  - B. Curiously, such theories were used simultaneously both for and against the reliability of biblical narratives. Such perspectives had social and political backgrounds and implications.

1. The contemporaneous development of “higher criticism”—begun with J. G. Eichhorn’s *Die Urgeschichte* (1779), which stressed the historical contextualization of Genesis and uncovered its multiple authorship—played into this discussion.
  2. Some used the findings to reject Genesis entirely, but others saw it as liberating the Bible’s spiritual content by emphasizing its meager value for accurate history and chronology.
- IV. In the 19<sup>th</sup> century, two related splits appeared (particularly in Britain): between philosophical geologists and Mosaical geologists and between “high” and “low” biblical interpreters.
- A. The early 19<sup>th</sup> century saw the professionalization of geology—these professionals are known as the *philosophical geologists*.
  - B. Their opponents were the *Mosaical geologists*, who endeavored to conform scientific findings to literal readings of Genesis.
  - C. Significantly, there were clerics and believers in *both* groups; this fact disallows a simple science-versus-religion reading. Importantly, the division among churchmen broke down in large part along the lines of biblical criticism—between “higher” and “lower” criticism.
  - D. The divisions within geology and theology, then, reveal a social split between elite and popular.
    1. Methodological naturalism functioned to define professional geologists.
    2. The popular views stemmed in large part from an alienation from increasingly complex, esoteric, and professionalized scientific *and* theological communities.
    3. This cultural reaction would recur and would (in the United States) factor strongly in the rise of fundamentalism.
    4. Thus, social and intellectual distinctions proved to be of greater importance than religious distinctions in this scientific controversy.
    5. Mosaicist treatments found currency for much of the 19<sup>th</sup> century in popularizing texts.
- V. Questions about the age and origin of the universe are closely related to these issues.
- A. One of the earliest and most significant impacts of reason on faith involved speculation about creation.
    1. The Christian doctrine of *creatio ex nihilo* stemmed from rational arguments.
    2. Many theologians in the patristic and medieval periods wrote and speculated extensively about the creation (for example, its speed and form). They produced an entire genre of writings on this topic (hexameral treatises); these stressed naturalism.
    3. Spans of time, however, tended to remain short, in accordance with the homocentric view of creation.
    4. The notion of the eternity of the world (for example, in Aristotle) was clearly condemned.
  - B. The two rival 20<sup>th</sup>-century cosmologies—steady-state and Big Bang—have had important religious impacts but not in ways clearly marking off theistic positions from atheistic ones.
    1. The Big Bang model (proposed initially in 1927 by Georges Lemaître, a Belgian priest) in its final form upholds the Christian notion of a cosmos with a definite beginning and a *creatio ex nihilo*.
    2. It was embraced by Pope Pius XII in 1951 (to the chagrin of Lemaître, who avoided theological discussion).
    3. The (now-rejected) steady-state model’s loudest proponent, Fred Hoyle, frequently linked it to his atheistic and anti-clerical crusade; nonetheless, some found theological justification in it.
    4. Although it might violate the eternity criterion, it contained a continuing *creatio ex nihilo*.
- VI. Progressive increases in the age of the Earth and the age and size of the universe progressively undercut the homocentric perception; thus, scientific discoveries had a direct impact on theological ideas.

**Essential Reading:**

Lindberg and Numbers, *God and Nature*, chapters 12–13 (pp. 296–350).

**Supplementary Reading:**

Brooke, *Science and Religion*, chapter 7 (pp. 226–274).

**Questions to Consider:**

1. The social/educational split between professional (“philosophical”) geologists and Mosaicists continues in modified form to this day in the split between high-level research scientists and the general public (and, increasingly, government policymakers). How is this gap to be bridged? Can it be? Who would do it?
2. Pope Pius XII’s enthusiastic reception of Big Bang cosmology and the ancient age of the universe and Earth urges the question of why some modern American fundamentalists are opposed to the concepts. Analyze the background and context of the different responses.

## Lecture Ten

### Darwin and Responses to Evolution

**Scope:** Like Galileo, Charles Darwin occupies a central position in discussions of science and religion. This lecture looks at Darwin's theory of evolution and its complex reception in context. Although evolutionary ideas were already a topic of popular discussion in England, Darwin's natural selection and common ancestry ideas impinged upon several key theological issues. Most importantly, they provoked a wide range of responses from different religious and scientific figures. Not only could Darwinian ideas be used for diametrically opposed purposes, but also (contrary to common rhetoric), by the end of the century, many mainstream Christian thinkers had incorporated evolution (if not natural selection) into their religious views.

### Outline

- I. In 1859, Charles Darwin published his epochal *Origin of Species*; this was followed in 1871 by *The Descent of Man*. The responses, scientific and theological, were complex.
  - A. Three important features of Darwin's evolutionary principles were common ancestry, speciation through variation, and natural selection.
    1. *Common ancestry* holds that all species in existence today originate from a single ancient organism or a very small number of ancient organisms.
    2. Species come about through the *variation* of forms, organs, and instincts; these variations are random.
    3. *Natural selection* is the mechanism for speciation; useful variations promote survival and favor reproduction and are, thus, passed on to more progeny. In other words, useful variations are "selected for."
    4. Herbert Spencer referred to this last as "survival of the fittest."
  - B. It must be remembered that Darwin presented his ideas during a time of wider intellectual crisis, in which several related developments were ongoing.
    1. The "age of the Earth" issue was continuing, and higher criticism was a subject of hot controversy.
    2. Evolutionary thinking about the natural world, moreover, was not new.
    3. The sciences were now completing their professionalization, and part of this process was the exclusion of pronouncements on origins, purposes, and ultimate meanings.
- II. Darwin's ideas could have an impact on theology in many ways—many of which we have encountered in other contexts.
  - A. There was an impact on biblical authority, specifically in terms of the historicity of Genesis 1.
    1. Thus, theologians and others who held to strict interpretations of the Bible tended to reject Darwin's ideas.
    2. This, however, was not the main source of contention in the 19<sup>th</sup> century.
  - B. The argument from design, upon which so much English religious apologetic had been built, was undermined by the notion of random variations and natural selection.
    1. Indeed, Paley's 1802 book was an argument that adaptation indicated design, rather than a response to environmental changes, as proposed by Lamarck and others.
    2. The old problem of God's activity in the world was renewed if species can develop naturally without the need for special creation (that is, individual production by God).
    3. With the design argument undermined by random variation, atheism was again an issue—no superintendence, no God. The Princeton Presbyterian theologian Charles Hodge (1797–1878) thus equated Darwinism with atheism.
  - C. On an ethical level, both the distancing of God and the notion of "survival of the fittest" were seen as undercutting morality in human relations. A nature run by violent, brutal natural selection could not witness a merciful, benevolent God or instantiate morality.
  - D. The origin of man from lower organisms was potentially materialistic, if exception were not made for the soul.

1. Materialism was a tumultuous movement on the Continent; ideas of German materialists undergirded radical politics (for example, the politics of Karl Marx) and attacks on Christianity.
  2. German materialists, such as Ernst Haeckel (1834–1919) and David Friedrich Strauss (1808–1874), adopted evolution specifically to further their attacks on religion.
  3. Materialism was explicitly condemned by the First Vatican Council in 1870.
- E. Some found the “lower origins” of man undignified or unsuitable for the *imago Dei*. Yet others, such as the Baptist A. H. Strong (1836–1921)—even though a biblical conservative—argued that humans are no less human even if evolved from beasts.
- III. Contrary to much mythology, religious leaders were significantly divided in their reception to Darwinism.
- A. Although some argued that it undermined Christianity, many others saw evolution as consistent with a divine plan and even as *proof* of divine purpose in the world.
    1. A necessary background is Robert Chambers’s *Vestiges of a Natural History of Creation* (1844), which envisioned a plan “programmed into” creation by God at the beginning.
    2. Even Thomas Henry Huxley (“Darwin’s bulldog”) initially expressed reservations about evolution because it seemed too progressivist and, thus, religious.
    3. A sense of progress still spoke to purpose and design (in his later years, Darwin rejected progressivism) and fit nicely with Victorian social and political ideas of “progress.”
  - B. The use of Darwin’s ideas could be completely dimorphic.
    1. Some found in Darwin support for the biblical teaching that all mankind had a common ancestor (*monogenism*).
    2. But others used it to support *polygenism* (multiple origins of humanity), which in turn, supported racism and colonialism through “survival of the fittest.”
  - C. Religious motives sometimes played a role in *spreading* evolution.
    1. Liberal theologians were anxious to distinguish themselves from conservatives who stuck to biblical literalism.
    2. Contrariwise, there has been, throughout the 20<sup>th</sup> century, a tendency for some less educated Protestants to assert and reinforce religious identity through opposition to evolution more than through theological principles.
  - D. Catholics, who tended to be neither biblical literalists nor wedded to the argument from design, were concerned primarily about the danger of materialism.
    1. Saint George Mivart (1827–1900), an anatomist, opposed natural selection as the mechanism for evolution in favor of theistic evolution.
    2. In 1950, Pius XII gave conditional support to evolution, and in 1996, John Paul II declared it “more than a hypothesis.”
    3. At the same time, both popes continued the Church’s opposition to materialistic interpretations; the soul exists and is not a product of evolution.
- IV. By the 1890s, there was nearly universal acceptance of the concept of biological evolution (transformation of species) but little for natural selection as the mechanism.
- A. Most interpreters of Genesis had settled on the *Day-Age theory* or *Gap theory*.
    1. According to the Day-Age theory, each of the six days of creation represented a vast geological epoch.
    2. According to the Gap theory, there was a vast period of time between the creation of heaven and Earth and the rest of creation.
  - B. Many theologians and scientists embraced *theistic evolution*, the idea that God guides or directs evolution.
    1. This system was worked out extensively by Darwin’s American proponent, the Harvard botanist Asa Gray, and was adopted (in the case of humans) by Alfred Russell Wallace, the independent originator of natural selection.
    2. Within theistic evolution, the level of God’s involvement can span a very broad range.
  - C. The diversity of responses to and reworkings of Darwinian theory by theologians and religious scientists forbids the making of facile, sweeping generalizations about the interaction between evolution and Christian thought.

**Essential Reading:**

Lindberg and Numbers, *God and Nature*, chapter 15 (pp. 369–390).

John Paul II, “Address to Pontifical Academy of Sciences,” 22 October 1996.

**Supplementary Reading:**

Brooke, *Science and Religion*, chapter 8 (pp. 275–320).

**Questions to Consider:**

1. Polygenism (and, to a lesser extent, Darwinian evolution itself) was used by some to justify slavery and racism. To what extent is it reasonable to oppose a scientific idea, theory, or development on the grounds that it leads to ethically objectionable positions? Can you think of other examples?
2. Consider the Day-Age theory and Gap theory (as well as St. Augustine’s exegesis). How do we know where to start and stop in interpretations of Scripture? What are the messages that Christians need to preserve from Genesis 1? Consider arguments for the varying degrees of literalism as applied to Genesis 1 (or to the rest of Scripture).



## Lecture Eleven

### Fundamentalism and Creationism

**Scope:** Despite the wide acceptance of evolutionary ideas by naturalists and prominent theologians in 1900, the 20<sup>th</sup> century has been marked by the strongest ever science-religion conflict in regard to evolution. The 1925 Scopes Monkey Trial, famed in popular imagination, on stage, and in film, was a highpoint in the 1920s fundamentalist crusade against evolution. In fact, the trial was part setup, part publicity stunt, although it soon ran out of control. This lecture looks not only at the Scopes Trial but also at its successors, as well as the invention of creation science and flood geology. Also important here is a brief analysis of the historical background and social (anxiety) foundations of American fundamentalism, a force that continues to play a largely adversarial role with modern science.

### Outline

- I. In the United States, recent science-religion issues have most often involved the opposition of fundamentalists to science and scientists.
  - A. Surprisingly, there is more opposition to evolution and other scientific topics in the United States today than there was at the end of the 19<sup>th</sup> century.
    1. By 1900, most American clergy had accommodated some form of an ancient Earth and evolution into their beliefs.
    2. The rise of fundamentalism would change this situation within a generation.
  - B. Fundamentalism as a movement began in the early 20<sup>th</sup> century.
    1. The name derives from a set of 12 tracts, *The Fundamentals*, published in 1910–1915.
    2. Fundamentalism contains an aggregate of beliefs, including naïve literalism, biblical inerrancy, and the residuals of 19<sup>th</sup>-century millenarist sects.
    3. Nineteenth-century millenarianism undergirds the first two beliefs; 19<sup>th</sup>-century America was awash with prophets of doom, predicting the apocalypse. The roots of this movement lay in dispensational millennialism, a new 19<sup>th</sup>-century notion that there were seven ages to human history marked by different ways—*dispensations*—that God tried to deal with humanity. Millenarians believed they were living in the sixth age, soon to be followed by an age of tribulation—the millennium. They wanted to determine exactly when the millennium would begin.
    4. Millenarianism gave rise to many apocalyptic beliefs and movements, including the continuing fundamentalist obsession with the New Testament Book of Revelation.
    5. Thus, naïve literalism and biblical inerrancy became a natural consequence of millenarianism, given its preoccupation with calculating dates from specific biblical passages.
    6. Fundamentalism is as much a social as a religious movement; its views are group-defining.
    7. Fundamentalism is a reactionary movement. Key stimuli are social anxiety over the loss of the old order (a religiously oriented Anglo-Saxon Protestant America) and fear of perceived foes: urban and learned culture, modernity, intellectuals, industrialization, immigration, and so on.
    8. Accordingly, its origins overlap those of the second Ku Klux Klan.
  - C. The fundamentalists’ “hot-button” issues have changed over time.
    1. Initial opposition was largely to higher criticism; even evolution was treated benignly in *The Fundamentals*.
    2. The explosion of fundamentalist belligerency dates from the period of World War I and its aftermath.
    3. The enormous growth of public high schools in the period 1900–1920 exposed rural populations to modern science; thus, evolution became a key issue.
    4. Since that time, other reactionary issues have been added, for example, opposition to the civil rights movement, women’s rights, and so on.
- II. Fundamentalists gained wide exposure in the famous Scopes Monkey Trial of 1925.
  - A. Contrary to dramatic depictions in film and on stage (*Inherit the Wind*), the trial was actually a setup.

- B. Tennessee, under fundamentalist pressures, passed a law (the Butler Act) in 1925 banning the teaching of evolution.
    1. The ACLU sought a test case.
    2. The town leaders of Dayton asked a teacher, John T. Scopes, if he was willing to stand as a defendant in order to provide a case; he agreed.
    3. Town leaders hoped that the trial would bring publicity and visitors (with money) to a struggling town.
    4. The result was as much circus as trial.
  - C. Big guns showed up for the legal team: William Jennings Bryan for the prosecution and Clarence Darrow for the defense.
    1. Bryan had begun crusading against evolution in 1922; his influence was key in passing the Butler Act.
    2. He extended his populist credo in an aggressively anti-intellectual way to science.
    3. Nonetheless, his opposition to evolution was not solely demagoguery; it partly reflected his traditional messages of labor rights and human dignity, which he felt were imperiled by the common origins theory.
    4. The surprise drama occurred when Bryan took the stand and was made to appear a buffoon by Darrow.
  - D. The trial was eventually restricted to the narrow question of whether or not Scopes broke the law; scientific and theological experts were not allowed to testify.
    1. Scopes, who never took the stand, was convicted and fined \$100.
    2. This sentence was overturned on a technicality, preventing the case from reaching the Supreme Court.
  - E. Fundamentalists receded from the scene after the 1920s, but evolution also receded from biology textbooks, owing to book publishers' concerns about sales.
- III. After 30 years of dormancy, fundamentalist opposition to evolution returned in the 1960s.
- A. This return was sparked by improved secondary school education in the rural South and Midwest.
    1. Following Sputnik, improved science education was promoted at the federal level; one result, in 1963, was the Biological Sciences Curriculum Study (BSCS), which produced a massively improved high school biology textbook, containing evolution.
    2. This curriculum set off a new wave of attempts to ban evolution, but the old bans (in Arkansas) were overturned by the U. S. Supreme Court in 1968.
  - B. After this failure, fundamentalists turned to the equal-time strategy. Thus, creation science was promoted as an alternative to evolution.
  - C. Creationism can be difficult to discuss because an enormously wide range of distinct viewpoints can coexist under the name.
    1. *General* creationists affirm only in a nonspecific way that God is the ultimate creator, while *special* creationists assign God specific tasks.
    2. Special creationists are divided into *progressive* and *strict*; the former interpret the Bible allegorically, while the latter take it literally as a scientific text.
    3. Progressive creationists are yet further divided into those who limit God's actions to a single act or very few acts (for example, initiating life), and those who require a separate creative act for each species or genus.
    4. Strict creationists are likewise divided into those adhering to the Gap theory, who envision a long epoch before the six days, and the Young-Earth creationists, who consider the Earth less than 10,000 years old.
    5. Thus, when speaking of creationists, we have to be very careful to identify specific groups accurately.
  - D. Creation science represented strict creationist views, generally of the Young-Earth sort; while it originated in the 1960s, its roots are older and based in *flood geology*.
    1. In 1923, George McCready Price, a Seventh-Day Adventist, published *The New Geology*, which held that the strata and the fossil record were relics of Noah's Flood.
    2. In 1961, *The Genesis Flood* by Henry M. Morris and John Whitcomb revived Price's claims.
    3. One result was the founding of the Creation Science Society in 1963.
    4. Initially successful equal-time arguments, however, were turned back in 1987 when the Supreme Court recognized creation science as religious doctrine, not science.

- E. The next shift was to mask identifiably religious content in order to pass constitutional muster—the result was *neocreationism*, of which Abrupt Appearance theory and Intelligent Design form a part.

**Essential Reading:**

Edward J. Larson, *Summer for the Gods*.

Lindberg and Numbers, *God and Nature*, chapter 16 (pp. 391–423).

**Supplementary Reading:**

George M. Marsden, *Understanding Fundamentalism and Evangelicalism*.

**Questions to Consider:**

1. It has been suggested that in modern America, the so-called battle between science and religion is, in fact, a face-off between learned/elite science and religion and unlearned/“popular” science and religion. Consider this interpretation and come up with evidence for and/or against it.
2. What is a *shibboleth*? (And where does the word come from?) It has been remarked that opposition to evolution is a *shibboleth* (rather than a rationally held belief) for many fundamentalists. Consider this suggestion and see if you can identify *shibboleths* for scientific opponents of fundamentalist anti-evolutionism.

## Lecture Twelve

### Past, Present, and Future

**Scope:** In this concluding lecture, we survey what we have seen and learned in this course and endeavor to place our own times in historical context. Notably, we conclude that no single blanket description is satisfactory for describing the complexity of science/religion interactions in Christianity over time. The productive engagements between science and theology should be duly stressed. Much of the current-day clashes occur between extremists—religious and scientific fundamentalists. This lecture proposes that the historical perspective is the best way to transcend and defuse such clashes. The extremist groups ignore historical background (theological and scientific) in favor of self-promoting mythologies, trivialize or fail to understand complex philosophical issues worked out in the past, and are not representative of the totality of science or of Christianity. Historical sense allows us to lift the potentially valuable discourse about and between science and religion to higher, more intellectual, and productive levels.

### Outline

- I. The interactions between science and religion have been complex over time and are not reducible to simple blanket descriptions.
  - A. The warfare thesis depends on the existence of separate “camps” of theologians and scientists; this is a relatively recent division.
  - B. The movement of ideas back and forth between theological and scientific thought has been more usual.
    1. Scientific and theological thought have grown up together in Western thought and share several methods and aspirations.
    2. Christian theology developed certain methods, perspectives, and cultural environments key to modern scientific inquiry.
    3. The Christian Church has provided important institutional support (patronage) for studies of the natural world.
    4. Likewise, science has provided theology with a truer sense of man’s place in the natural world.
    5. Christian theology has proven itself remarkably flexible in its ability to adopt, adapt, and explore new scientific findings.
- II. Although clearly false as a historical model, the warfare thesis seems supported by current events, particularly involving evolution.
  - A. A historical perspective provides a clearer view of the real status of the current debates and points out particular features of interest.
  - B. Science and theology have experienced nearly opposite trajectories in terms of professionalization, authority, and status.
    1. Scientific activity has been regularized by professionalization, granting it greater authority.
    2. Theological activity has become diffused by decreased ability to professionalize theologians; the result has been lower-level theology and a loss of status and authority.
    3. This trend in theology is exemplified by the triviality of the theological content of the anti-evolution debate (biblical literalism) relative to historical theological issues.
  - C. Historical study holds the promise to correct this problem by indicating the diversity and complexity of past theological debates and responses.
    1. Traditional Christian theology shows biblical literalism to be a non-issue.
    2. Consider, for example, the case of B. B. Warfield (1851–1921), the strong defender of biblical inerrancy who also supported evolution.
    3. The historical background, once known, forces people to ask what makes biblical literalism/evolution an issue now.
    4. One cause may simply be unfamiliarity with historical theology and current “high-end” (that is, philosophically sophisticated) theology.
    5. Thus, the study of history is again a solution.

- III. Rather than merely exemplifying the warfare thesis, both parties involved in the current controversy have adopted it as a model for their own behavior.
- A. A warfare metaphor appeals to the Manichean mindset of many fundamentalists.
  - B. Some scientists, crusading for materialism and atheism, support fundamentalist fears.
    - 1. Such scientists have often forgotten the difference between a *professional policy* of not invoking supernatural action and a *personal credo* against everything supernatural.
    - 2. Historical perspective (again) reminds us of the difference.
    - 3. Scientists should avoid making theological or metaphysical claims when they are unqualified to do so.
    - 4. An example is the assertion that the inherent randomness of mutation and contingency of natural selection excludes the possibility of divine guidance of evolution. This position is refuted by the 2002 statement “Communion and Stewardship” by the International Theological Commission.
  - C. The loudest combatants in the evolution controversy are both extremists.
    - 1. Their arguments tend to harden positions and create division where it need not exist.
    - 2. The perception of the controversy ignores the vast field of cooperation and intelligent conversation by the majority in between.
    - 3. Fundamentalists do not have the right to speak for Christianity; declamatory supporters of scientism do not have the right to speak for science.
  - D. What both lack is a sense of humility before the complexity of the world and man’s place in it.

**Essential Reading:**

International Theological Commission, “Communion and Stewardship,” chapter 3, esp. sections 61–80.

**Supplementary Reading:**

Brooke, *Science and Religion*, Postscript (pp. 321–347).

**Questions to Consider:**

1. At several points in this course, the issue of authority has emerged, either explicitly or implicitly. (For example, who speaks for science? Who speaks for theology? How does one decide between rival scientific interpretations or between rival theological perspectives?) Think about how authority is gained and how it is respected (or not) in an ideal world and in the real world. How does one achieve the ability to speak authoritatively about scientific issues? About theological issues? Do the answers to the previous two questions differ? Should they?
2. There are certain basic beliefs and practices that are integral to Christianity (that is, without these beliefs and practices, the religion would not be Christian), for example, the statements of the Nicene Creed. Are there analogous basic beliefs and practices for science? What are they? What would be the consequences of abandoning them?

**Note:** I ended the final lecture with the Latin phrase *Ite missa est*, meaning literally, “go, it is sent.” These words are borrowed from the last line of the Latin Tridentine Mass (in fact, the term *Mass* is derived from this concluding line). My intent was not only to arrest your attention and curiosity but also to draw upon the rich associations and multiple meanings of the phrase (in a non-sacrilegious way, I trust) to imply that although I have sent you some thoughts and now the course is ended, the issues covered pass far beyond the short duration of these lectures. Thus, I intend the line to be taken as gentle encouragement to continue your study and consideration of science and religion issues as encountered in everyday life.

## Timeline

- 313 ..... Edict of Milan legalizes Christianity in the Roman Empire.
- 325 ..... Ecumenical Council of Nicaea.
- 354–430 ..... Life of St. Augustine.
- 410 ..... Rome sacked by Alaric.
- 476 ..... Last of the (western) Roman emperors slain by the barbarian Odoacer.
- 800 ..... Charlemagne crowned Holy Roman Emperor.
- c. 1020 ..... School of Chartres founded.
- c. 1200 ..... University of Paris established; Oxford, about 20 years later.
- 1205 ..... St. Dominic founds the Order of Preachers (Dominicans).
- 1257 ..... St. Thomas Aquinas begins teaching at Paris.
- 1277 ..... Condemnation of 1277; 219 propositions condemned at the University of Paris.
- 1540 ..... Society of Jesus (Jesuits) established.
- 1543 ..... Copernicus’s *De revolutionibus* published.
- 1545–1563 ..... Council of Trent.
- 1610 ..... Galileo’s telescopic discoveries appear in the *Sidereus Nuncius*.
- 1616 ..... Copernicus’s book is “suspended until corrected”; Galileo told not to teach Copernicanism as true.
- 1618–1648 ..... Thirty Years’ War ravages central Europe.
- 1620 ..... Plymouth colony established in Massachusetts.
- 1627 ..... Robert Boyle born.
- 1632 ..... Galileo’s *Dialogues on the Two Chief World Systems* published; the next year, he is tried and abjures.
- 1642 ..... Birth of Newton; death of Galileo.
- 1658 ..... Gassendi’s natural philosophical system published.
- 1660 ..... Royal Society of London founded; given Royal Charter in 1662.
- 1669 ..... Steno’s work on fossils and strata published.
- 1692 ..... Boyle Lectures commence.
- 1749 ..... Buffon’s first theories on the origin of the Earth appear.
- 1776 ..... American Declaration of Independence.
- 1779 ..... Eichhorn’s *Urgeschichte* launches “higher criticism.”
- 1796 ..... Laplace’s nebular hypothesis.
- 1802 ..... Paley’s *Natural Theology* published.
- 1807 ..... Geological Society of London founded.
- 1830s ..... *Bridgewater Treatises* published.
- 1831–1836 ..... Darwin’s trip around the world on HMS *Beagle*.

- 1844 ..... Anonymous publication of *Vestiges of the Natural History of Creation*.
- 1844 ..... In the United States, the world fails to end (again).
- 1859 ..... Darwin's *Origin of Species* published.
- 1874 ..... Hodge's *What Is Darwinism?* and Draper's *Conflict* published.
- 1896 ..... White's final two-volume treatment of his warfare thesis published.
- 1910–1915 ..... *The Fundamentals* printed and widely distributed.
- 1914–1918 ..... World War I.
- 1925 ..... Scopes' Monkey Trial.
- 1927 ..... Lemaître proposes an expanding universe and a "primordial atom."
- 1968 ..... Laws forbidding the teaching of evolution struck down by the U.S. Supreme Court.
- 1990s ..... The term *intelligent design* is coined; legal wranglings over the teaching of evolution in public schools continues in the United States.

## Glossary

**accommodation (doctrine of):** An idea, proposed by St. Augustine and others in the patristic period and essentially universally accepted by mainstream orthodox Christianity, that biblical expressions were “accommodated” to the limited understanding and knowledge of the primitive people that made up their original audience.

**ancilla:** Latin for “handmaiden”; compare the English derivative *ancillary*. Used in the history of science to describe the status of the natural sciences relative to theology in the Middle Ages, as enunciated most influentially in the writings of St. Augustine and other patristics.

**biblicism:** A theological position holding that the Bible is the sole source of authority for Christianity. Accepted in varying degrees by Protestants; rejected by Catholics and Orthodox.

**collectivism:** In this context, a fallacy in historical methodology whereby the positions held by a single or small number of individuals are unwarrantably attached to a wider group to which they are considered to belong.

**communis cursus naturae:** Literally, “the common course of nature”; in other words, the routine, ordinary, and usual ways in which natural phenomena occur.

**Council of Trent:** A highly significant meeting of Catholic theologians and hierarchy that took place in the northern Italian city of Trento from 1545 to 1563. The purpose was to address the problem of Protestantism by internal reforms, regularization of doctrine, and measures to prevent further schism.

**creatio ex nihilo:** “Creation out of nothing,” an article of Christian faith stressing that God alone is eternal and is the creator of everything.

**creation science:** A body of notions proposed, beginning in the 1980s, as an “alternative” to accepted scientific ideas regarding geological and cosmological history and, especially, biological evolution. Creation science bases itself on naïve literalist readings of Genesis 1 and flood geology.

**creationism:** Generally speaking, any view that posits a creation of the world by God. There are, however, enormously broad varieties of views that can fall under this rubric, ranging from Young-Earth creationism at one end (that is, the Earth is less than 10,000 years old and Genesis 1 is a literally true account of creation) to simply positing a single initial creative act (such as initiating the Big Bang).

**criticism, higher and lower:** Two views on how to interpret the Bible. Higher criticism, initiated in the 18<sup>th</sup> century, applies the standard textual tools, applicable to any historical text, to the Bible and asks questions about authorship, original context, influences, and so on. Lower criticism rejects such tools.

**Day-Age theory:** A position on the interpretation of Genesis 1 that holds that the “days” of creation refer to enormous epochs of time.

**deism:** A theistic position in which the deity is envisioned as impersonal, that is, a rejection of the Christian (or Jewish or Islamic) God.

**design argument:** An argument for the existence of God based on the belief that there is design in the visible world and, thus, a designer.

**determinism:** The idea that future events are pre-determined; there is no free will.

**dualism:** In the context of this course, the division of the world into contending good and evil forces; see **Manicheanism**.

**epistemology:** The study of knowledge; epistemology studies what we know (or can know) and how we know it (or think we know it).

**fideism:** An approach to religion that emphasizes faith at the expense of reason and, in its stronger expressions, holds that no part of the body of faith can be subjected to rational inspection or analysis; an inherently *anti-theological* position.

**flood geology:** The use of Noah’s Flood as an explanation for geological phenomena (mountains, fossils, canyons, and so on). Although such ideas were suggested tentatively in the late 17<sup>th</sup> century, a distinct “flood geology” is the



product of the 19<sup>th</sup> and 20<sup>th</sup> centuries and was an explicit reaction against scientific geological views of an ancient Earth.

**Gap theory:** A position on the interpretation of Genesis 1 that holds that although the “days” are actual 24-hour periods, an immense span of time can be inserted either before the six days or between certain days.

**geocentric:** Literally, “Earth-centered”; used to refer to the Aristotelian, Ptolemaic, and Tychonic systems, in which the Earth is at the center of the cosmos.

**geokinetic:** Literally, “Earth moving”; used to refer to cosmic systems in which the Earth is in motion, such as the Copernican system.

**geostatic:** Literally, “earth stationary”; used to refer to cosmic systems in which the earth is at rest.

**God of the gaps:** An unsatisfactory view of God generated when divine intervention is called upon to “fill in” gaps (generally temporary) in otherwise natural explanations of the natural world.

**heliocentric:** Literally, “Sun-centered”; used to refer to the Copernican system. (Actually, Copernicus’s system has the Sun slightly off center and is more rigorously labeled heliostatic, that is, with a stationary Sun.)

**hexameral treatises:** A genre of theological writings of the patristic and medieval periods. Hexameral (derived from the Greek for “six days”) treatises are commentaries on Genesis 1; as such, they were important loci for serious inquiries and theories about scientific subjects.

**instrumentalism:** A view that holds that our scientific theories and explanations are not (or need not) be literally true and are satisfactory as long as they “save the phenomena,” that is, give a plausible and consistent explanation of what we see. Theories are instruments or tools, not final explanations. Compare **realism**.

**literalism, naïve:** A kind of biblical interpretation that holds that the “surface meaning” of the Bible is literally true. Naïve literalism, popular among fundamentalists and many evangelicals, is a fairly modern innovation—dating after the Protestant Reformation—and needs to be distinguished from more traditional literalism (such as that of St. Augustine). Traditional literalism holds that the literal meaning of many scriptural passages can be saved in only a general sense via careful interpretation and exegesis, *not* that the “surface meaning” is true.

***machina mundi*:** Literally, “the machine of the world,” a conception of the universe as a giant mechanism which operates in orderly and predictable ways. The concept of the *machina mundi* began to emerge in the Middle Ages, but became strongest in the 17<sup>th</sup> century within the concept of the mechanical philosophy.

**Manicheanism:** Strictly speaking, a religious movement based on the teachings of the Persian self-styled prophet Manes and containing a farrago of notions drawn from astral religions, Zoroastrianism, and Christianity. Main tenets include dualism—the constant conflict between good and evil forces/deities—the belief that matter is evil. As a heretical movement, it was popular in parts of the Roman world in the patristic period (it seduced St. Augustine in his youth), and in various altered forms, it has continued to erupt occasionally in various locales; the mindset of American fundamentalism is substantially Manichean.

**materialism:** The view that material substance is all that exists—no soul, no spirits, no God.

**mechanical philosophy:** A collection of worldviews popular in the 17<sup>th</sup> century, characterized by the vision of the world as a machine in which the sole basis for natural phenomena was matter and motion.

**monogenism:** The position that all human beings are related by virtue of being descended from a single common ancestor. **See polygenism.**

**natural theology:** The use of the natural world as a source of information about God and his attributes. Although the belief that the natural world could reveal something about God dates to Classical antiquity (and before Christianity, for example, in Cicero), a distinct “natural theology” appeared only in the late 17<sup>th</sup> century, largely in Protestant contexts, and was popular predominantly in England in the 18<sup>th</sup> and 19<sup>th</sup> centuries. Compare **design argument**.

**naturalism:** The use of natural forces alone to explain the causation of phenomena. It is important to distinguish *methodological naturalism* from *philosophical naturalism*. The former is one of the fundamental “rules of the game” of modern science (and the general tendency of medieval natural philosophy and theology, as well) and holds

only that we are not allowed to invoke divine interventions as explanations of things we do not understand. It makes *no* claims about the existence of God or his interventions in the world, only that it is not acceptable to use such as explanations in a scientific context. Philosophical naturalism, however, is a more radical view that denies the existence of anything supernatural (that is, “above nature”). All philosophical naturalists are, by definition, methodological naturalists, but not all methodological naturalists are philosophical naturalists.

**normative:** Ideas or notions that are set down as a rule or norm and endeavor to make claims about the way things should be.

**occasionalism:** A philosophical position that holds that natural objects have no inherent causative power, that the connections we see between cause and effect are merely apparent, and that effects are actually the direct result of divine activity. In other words, there is no secondary causation.

**philosophers’ stone:** A substance prepared in the alchemical laboratory by a secret process that, when cast upon a quantity of molten metal, transmutes it in a few minutes into pure gold (or silver). The philosophers’ stone is first mentioned in the writings of Hellenistic Egypt (c. A.D. 300) and was a chief pursuit of alchemists down to the 18<sup>th</sup> century.

**polygenism:** The position that there are several distinct and unrelated races within the human species as the result of descent from several different ancestors. A position condemned by the Catholic Church. **See monogenism.**

**primary causation:** Causation that stems directly from the First Cause, that is, God (see **secondary causation**).

**rationalism:** The view that everything in existence is accessible to and explicable by human reason.

**realism:** A view that holds that our scientific theories and explanations are (or should be) literally true descriptions of reality (“the way things really are”). Compare **instrumentalism**.

**recta fides:** Literally “right faith”; namely, the belief in things in which it is correct or proper to believe, as opposed simply to indiscriminate belief.

**recta ratio:** Literally “right reason”; namely, rational methods applied correctly and fitly. Since human reason can often lead to false conclusions, there must be a distinction between its proper and improper usages.

**scientism:** A view that exalts the status of science and scientific inquiry (of course, in the modern, current, Western sense of the word) to an absolutely predominant position, capable of solving, explaining, and/or passing judgment on everything. In some cases, it is equivalent to science as religion.

**secondary causation:** Causation that stems from any created (secondary) cause, that is, from anything other than God (see **primary causation**).

**supernaturalism:** The use of supernatural forces and interventions to explain the causation of phenomena.

**theistic evolution:** The position that evolution has been, in some sense, guided by God. The degrees of “guidance” envisioned span a vast range, from multiple direct intercessions (primary causations) to create new species or variants to a chain of secondary causations (either necessary or contingent) stretching back through billions of years to a single, initial primary causation at the moment of creation.

**theology:** The rational and intellectual study of God, his attributes, activities, and relationship to the creation.

## Biographical Notes

**St. Augustine of Hippo** (354–430): Probably the most influential and important Christian theologian of all time. Born at Tagaste in North Africa (currently in Tunisia) of a Christian mother and pagan father, Augustine studied philosophy and rhetoric at Carthage; went to Rome and Milan, where he was baptized; then returned to North Africa, where he became bishop of Hippo and founded a monastery. A prolific and highly learned writer whose voluminous works were well known and esteemed throughout the Middle Ages (and down to the present day among the *cognoscenti*), he effected a powerful synthesis of Christianity and Greek philosophical thought, oversaw important Church councils, and laid the foundations for the accepted methods of biblical interpretation.

**Bellarmino, St. Roberto** (1542–1621): A native of Montepulciano in Tuscany, Bellarmino distinguished himself as the preeminent theologian of the Counter-Reformation. He studied at the Jesuit college of his hometown and entered the Jesuit Society in 1560. He then studied at Rome, Padua (1567–1569), and Louvain (from 1569); returned to Italy in 1576; and became a member of the Collegio Romano. He was made cardinal in 1599 and bishop of Capua in 1602; at the conclave of 1605, he was advanced as a candidate for pope, but he refused to accept. Bellarmino dealt with Galileo, with whom he was on friendly terms, during the first phase of his inquiry (1612–1616). He gave away all his goods to the poor and died a pauper. His canonization occurred in the early 20<sup>th</sup> century.

**Bentley, Richard** (1662–1742): Born in Yorkshire, Bentley was educated at Cambridge (B.A., 1680; M.A., 1683), took Anglican Holy Orders in 1690, and became Keeper of the Royal Library in 1693, Fellow of the Royal Society in 1695, and D.D. in 1696. In 1700, he became master of Trinity College, Cambridge (Newton's college). His best known work is as a Classicist, but he was also the first Boyle lecturer (1692–1695), where he used scientific information gleaned from Newton in the defense of revealed religion.

**Boyle, Robert** (1627–1691): Seventh son and fourteenth child of the wealthy Richard, Great Earl of Cork. Boyle was schooled at Eton and tutored during a Continental Grand Tour. His first career was as a moralist, but around 1650, his interests turned to natural philosophy. He relocated to Oxford in the mid-1650s, where he participated in an "Experimental Club." There, he set the foundations of his scientific career. Boyle later moved to London and took up residence with his sister, with whom he lived the rest of his life. He helped found the Royal Society in 1660, published a book (either on science or theology) nearly every year after 1659, and became the most celebrated natural philosopher in Britain. Unlike Newton, he was of a pleasant disposition and highly charitable and maintained correspondence with hundreds of savants across Europe. He was offered the presidency of the Royal Society, the knighthood, and ordination as a bishop, but he refused. His legacy funds an annual lecture on Christianity and, in the early years, supported an "Indian college" at William and Mary.

**Buffon, Georges-Louis Leclerc, Comte de** (1707–1788): An important French naturalist, member of the Académie Royale des Sciences and other learned societies, and head of the Jardin du Roi from 1739. His interests ranged over botany, mathematics, and mechanics. His most famous work is the 36-volume *Histoire naturelle*. He also proposed an origin for the solar system in the *solar ejecta* following the collision of a comet with the Sun.

**Burnet, Thomas** (c. 1635–1715): Educated at Cambridge and ordained an Anglican priest, Burnet's claim to fame is his authorship of *A Sacred Theory of the Earth*, first published in Latin in 1681, then in English in 1684, and revised and expanded thereafter. This work endeavored to work out a geology and chronology of the Earth from creation to the final conflagration and to explain geological observations in terms of biblical events. It was criticized at the time on both scientific and exegetical grounds.

**Caccini, Tommaso** (1574–1648): A minor Dominican friar at Santa Maria Novella in Florence who preached a sermon against mathematicians in general and Galileo in particular on the fourth Sunday of Advent in 1614. His superior apologized to Galileo for the incident. He had previously been disciplined by the archbishop of Bologna as a troublemaker.

**Castelli, Benedetto** (1578–1643): Born in Brescia, Castelli entered the Benedictine order in 1595 and studied with Galileo in Padua from about 1604 to 1607. Castelli helped Galileo in various activities, including his publications and solar observations. Galileo recommended Castelli for the chair of mathematics at the University of Padua, and the two remained fast friends. In 1626, Castelli moved to Rome as a consultant on river management and professor of mathematics. He wrote on hydraulics, optics and vision, and other subjects.

**Copernicus, Nicolaus** (1473–1543): Born in Torun, Poland, Nicolaus was orphaned young and raised by his uncle, the bishop of Warmia. He studied at Krakow (1491–1495) first, then canon and civil law and medicine in Italy. He received the post of canon at Frauenburg from his uncle in 1497, where he took up residence (for the rest of his life) in 1510. He is best known for advancing the heliocentric theory, presented in his book *De revolutionibus* (1543).

**Descartes, René** (1596–1650): Born at La Haye, Descartes was educated at the Jesuit college of La Flèche (1606–1614), then studied law at Poitiers (1614–1615). He left France for the Netherlands, where he conducted further personal studies, wrote and published profusely, and corresponded widely. His natural philosophical system attracted numerous adherents for a century, and his mathematical innovations (for example, Cartesian coordinates) continue to be fundamental.

**Draper, John William** (1811–1882): Born in England, Draper emigrated to the United States, where he received an M.D. at the University of Pennsylvania and became a professor of chemistry, researching light and its chemical activity (including photography). He was elected president of the American Chemical Society. He turned to historical writing (embracing positivism) and wrote the enormously popular *History of the Conflict between Religion and Science* (1874), from whose erroneous claims, false assumptions, and melodrama we are not yet free more than a century later.

**Eichhorn, Johann Gottfried** (1752–1827): Eichhorn has been called the “father of modern Old Testament criticism,” that is, higher criticism. Born in Germany and educated at Göttingen, he became professor of oriental languages at Jena in 1775. In 1778, he moved to a professorship at Göttingen, where he lectured on oriental languages, exegesis, and political history. He treated the Bible as an ancient text open to all the critical tools of the scholar. Among his most important discoveries was the multiple authorship within the Pentateuch, or Books of Moses.

**Foscarini, Paolo Antonio** (1565–1616): Foscarini was a native of Calabria and joined the Carmelite Order. He taught philosophy and theology at the University of Messina and published on devotion, doctrine, divination, and cosmology. He founded a Carmelite monastery in his hometown of Montalto. Foscarini’s interest in the Copernican system resulted in a book entitled *Lettera sopra l’Opinione de’ Pittagorici, e del Copernico della Mobilità della Terra, e Stabilità del Sole, e del Nuove Pittagorica Systema del Mondo* (*Letter about the Opinion of the Pythagoreans and of Copernicus Concerning the Mobility of the Earth and the Stability of the Sun, and about the New Pythagorean System of the World*), published in 1615 during the first phase of the Galileo affair. The book, which gave new interpretations of Scripture designed to fit the Copernican system, was prohibited by the Index in 1616.

**Galilei, Galileo** (1564–1642): Born the son of Vincenzo Galilei, a noted composer and music theorist, Galileo began his education at the University of Pisa in 1580 but left without a degree in 1585. After work on Archimedean hydrostatics and the vibration of strings, he returned to Pisa in the chair of mathematics in 1589 and moved to Padua in 1592. After his celestial discoveries of 1609, Cosimo de’ Medici gave him a sinecure chair at Pisa and a position as philosopher and mathematician in his Florentine court. In 1615, Galileo was questioned by the Inquisition and, although found not guilty of the original (serious) charges, was told not to teach Copernicanism as literally true. After a series of complicated events, Galileo was questioned again in 1633 and shown to have transgressed the ruling of 1616; he recanted the notion of terrestrial motion and remained under house arrest at his villa in Florence the rest of his life, during which time he wrote arguably his most important book, *Two New Sciences*.

**Gassendi, Pierre** (1592–1655): Gassendi was born in Provence, entered the priesthood, studied at Aix-en-Provence, then earned a doctorate in theology at Avignon in 1614. In 1634, he became provost of the cathedral of Digne and was appointed professor of mathematics at the Collège Royal in 1645. His massive natural philosophical work, the *Syntagma philosophica* (aimed at replacing Aristotelianism with a revived atomic philosophy) was published posthumously in 1658.

**Halley, Edmond** (1656–1742): Halley was born in London and attended Oxford starting in 1673. He voyaged to St. Helena to study the stars of the southern hemisphere. He was elected Fellow of the Royal Society in 1678, became Savilian Professor of geometry in 1704, and Astronomer Royal in 1721. He is best known for his work on comets, notably predicting the return of the great comet of 1680 in 1756, a comet that ever since has borne his name.

**Hodge, Charles** (1797–1878): This influential Presbyterian theologian was principal of Princeton Theological Seminary from 1851 to 1878. He wrote extensively, embracing a conservative interpretation of Calvinist doctrine. His 1874 book *What Is Darwinism?* equated Darwinism with atheism.

**John Paul II** (1920–2005): Born Karol Józef Wojtyła in Wadowice, Poland, he entered the seminary in Krakow (then meeting secretly, owing to the Nazi occupation) in 1942, was ordained priest in 1946, and received the doctorate in theology in 1948. A professor at Lublin University, he became a bishop in 1958, archbishop of Krakow in 1964, cardinal in 1967, and on 16 October 1978, the 263<sup>rd</sup> successor to Peter as the first Polish pope. His pontificate lasted 27 years, the third longest in history, during which time he held more than 1,160 general audiences, oversaw the Jubilee of the Third Millennium, made innumerable speeches and statements, issued a large number of important teaching documents, created 231 cardinals, proclaimed 1,338 *beati* and 482 saints, traveled more than all previous pontiffs combined, and revised numerous Church mechanisms.

**Kepler, Johannes** (1571–1630): Kepler was born in Weil-der-Stadt, Württemberg, to a poor but noble family. He began seminary at Adelberg in 1584, but his talents enabled him to go on to the University of Tübingen in 1588, where he studied with Michael Maestlin. He accepted the job of astronomy lecturer at Graz in 1594. In 1600, he went to work with Tycho Brahe, who had recently transferred to Rudolf II's court in Prague; when Tycho died in 1601, Kepler inherited his post as imperial mathematician. For 12 years, he lived at Linz and was invited to London by James I and to a chair at Bologna but declined both. Kepler's life was fraught with problems from the outset: His parents became bankrupt, his wife and three children died young, his mother was tried as a witch, his salary was rarely paid, and he seemed always caught in sectarian crossfire.

**Lemaître, Georges** (1894–1966): The “father of Big-Bang cosmology” was born in Charleroi, Belgium; studied humanities at a Jesuit school; volunteered in the Belgian army in 1914; and after the armistice, began studies of physics and mathematics and for the priesthood. He received a Ph.D. in 1920 and was ordained in 1923. In the same year, he studied with Arthur Eddington at Cambridge, then with Shapley at Harvard, and finally, at the Massachusetts Institute of Technology. He returned to Belgium in 1925 and, in 1927, published a paper containing arguments for an expanding universe; his views were accepted only slowly, but he won over Einstein in 1935. Later in life, Lemaître was involved with computer development. He received numerous distinctions both Belgian and international, including membership in the Pontifical Academy of Sciences (1936), and was the president of that body from 1960.

**Lorini, Niccolò** (dates unknown): A minor Dominican friar at Santa Maria Novella in Florence. Wrote a letter of complaint against Galileo and his followers to the Inquisition, thus precipitating the Galileo affair.

**Mersenne, Marin** (1588–1648): Although initially a religious writer and supporter of Aristotle, Mersenne became one of the most important researchers and promoters of the “New Science” of the 17<sup>th</sup> century. He advocated a mathematical approach to nature and created a huge correspondence network and academy for the exchange of scientific ideas. A Minim friar from 1611 and priest from 1612, Mersenne was also a staunch supporter of Galileo by the early 1630s. He studied acoustics, mathematics, the speed of sound, the barometer, falling bodies, and other topics; encouraged other scholars, including Gassendi, Descartes, and Huygens; and published prolifically.

**Mivart, Saint George Jackson** (1827–1900): A Londoner by birth and a convert to Catholicism in 1844, Mivart became a noted anatomist and biologist. He studied under Huxley, beginning in 1859, and became a Fellow of the Royal Society. His best-known work is the 1871 *On the Genesis of Species*, which adopts evolution but not natural selection as the mechanism (a typical response of scientists of the period) and preserves the transcendence of the human soul. Late in life, Mivart espoused views that brought him into conflict with Cardinal Vaughan, who excommunicated him in 1900 (but *not* on the grounds of having adopted evolution, as is sometimes claimed).

**Newton, Sir Isaac** (1642–1727): Son of a yeoman farmer, Newton studied at Cambridge from 1661 to 1665; became Lucasian Chair of Mathematics in 1669, Fellow of the Royal Society in 1671, Master of the Mint in 1696, and president of the Royal Society in 1703; and received a knighthood in 1705. His discoveries in calculus, optics, and celestial motion date from the 1660s. His famed *Principia* was published in 1687 at the urging of Edmond Halley and was followed by texts on optics, ancient chronology, and prophecy. By all accounts, Newton was a difficult and occasionally erratic man.

**Paley, William** (1743–1805): Born in Peterborough, Paley attended Christ College, Cambridge, where he received his degree in 1763, became a fellow in 1766, and a lecturer in 1768. His lectures dealt primarily with moral

philosophy but also with metaphysics and the New Testament. He was ordained in 1767 and was an active opponent of the slave trade. He excelled as a writer of textbooks; thus, his arguments are rarely original but are presented with an elegant and compellingly clear style. His most influential book, *Natural Theology*, was published in 1802 and remained a standard of university curricula for half a century.

**Ray, John** (1627–1705): Educated at Cambridge in languages, mathematics, and natural science, Ray became an Anglican priest in 1660 and went on travels through England and the Continent collecting flora, fauna, and minerals. He was elected to the Royal Society in 1667. He published widely on scientific and theological topics, promoting biological classification systems and initiating the tradition of English natural theology in 1691 with his *Wisdom of God Manifested in the Works of the Creation*.

**Steno, Nicholas** (or **Niels Stensen**), **the Blessed** (1638–1686): Steno was born in Copenhagen and became an anatomist. His dissections were renowned for their care and the precision of his observations. After time in Paris, he went to Florence under the patronage of the grand duke of Tuscany. There, he took up a hospital position and membership in the Accademia del Cimento, one of the earliest scientific societies. He turned his attention to fossils and geology and, in 1669, produced his landmark work on rock strata. In 1667, he converted to Catholicism. The Danish king invited him home later that year, but Steno did not go until his freedom of religious practice was guaranteed, which was not forthcoming until 1672. In 1674, he returned to Florence. In 1675, Steno became a priest; in 1677, a bishop; and apostolic vicar to northern Europe. His last years were spent in northern Germany in ceaseless episcopal duties to the Catholic minority and ministry to the poor, and his larger work on strata remained unfinished. In 1988, he was declared a *beatus*; his feast day is 25 November.

**Thierry of Chartres** (c. 1100–1156): A scholar and teacher at the cathedral school of Chartres. Wrote an important hexameral treatise using Neo-Platonic notions and a commitment to naturalism.

**St. Thomas Aquinas** (1225–1274): Born in southern Italy, young Thomas was sent to be educated at Monte Cassino. Around 1243, he decided to enter the Dominican Order, to the chagrin of his parents, who apparently imprisoned him for a time to prevent the move. He then studied under St. Albert the Great at Cologne and received degrees at Paris, where he began teaching in 1257. His works included learned commentaries on Aristotle's writings and a host of theological treatises, particularly the comprehensive (but unfinished) *Summa theologiae*. Although some of his theses were initially considered heterodox by some, St. Thomas's work has become central to Catholic theology and has exercised enormous influence on Western philosophy.

**Urban VIII** (1568–1644): Maffeo Barberini was born into one of the most powerful families of Florence. He received an excellent education from the Jesuits and earned a doctor of laws degree from Pisa in 1589. He became a bishop and cardinal in the first years of the 17<sup>th</sup> century and was elected pope in 1623. As pope, he was a patron of the arts, encouraged missionary activity, and in 1629, outlawed slavery among the Indians in South America and the West Indies. He had been a friend and supporter of Galileo from at least 1610, but deeply offended and feeling betrayed by Galileo in 1632, Urban pressed for his trial.

**White, Andrew Dickson** (1832–1918): White had a diverse career as historian, professor, senator, and ambassador. As the co-founder and first president of Cornell University, he received strong criticism for his secular curriculum for the young institution. His response, from 1876 to 1896, was to write and deliver increasingly lengthy (and often rambling) discourses on the “warfare” between science and religion, which though propagandistic and enormously flawed, have had great influence to this day.

**William of Conches** (c. 1100–1154): Born in Normandy, which he calls “a country of mutton-heads and dense skies,” William studied at Chartres under Bernard, then began teaching there himself in the early 1120s. He seems to have had a special interest in natural philosophy. He retired early from the school and became tutor to the sons of Geoffrey Plantagenet (one of whom became England's King Henry II); Geoffrey is one of the interlocutors in William's superb survey of natural philosophy, the *Dragmaticon philosophiae*.

## Bibliography

### Essential Reading:

Brooke, John Hedley. *Science and Religion: Some Historical Perspectives*. Cambridge: Cambridge University Press, 1991. Excellent work on science and Christianity since the 16<sup>th</sup> century; chapters on the mechanical universe, the age of the Earth, natural theology, evolution, and more.

Dembski, William A. "Is Intelligent Design a Form of Natural Theology?" Available at [www.designinference.com/documents/2001.03.ID\\_as\\_nat\\_theol.htm](http://www.designinference.com/documents/2001.03.ID_as_nat_theol.htm). Major ID theorist deals with the title question; this document is part of his personal Web site.

Finocchiaro, Maurice A. *The Galileo Affair: A Documentary History*. Berkeley, CA: University of California Press, 1989. The essential work for understanding the Galileo affair; an excellent introduction laying out the issues and chronology. Contains about 250 pages of documents in English translation (including Galileo's pertinent writings and correspondence and all the Inquisition minutes), along with helpful appendices of explanatory notes, biographies, and other material.

International Theological Commission. "Communion and Stewardship." Available at: [www.vatican.va/roman\\_curia/congregations/cfaith/cti\\_documents/rc\\_con\\_cfaith\\_doc\\_20040723\\_communion-stewardship\\_en.html](http://www.vatican.va/roman_curia/congregations/cfaith/cti_documents/rc_con_cfaith_doc_20040723_communion-stewardship_en.html). Interesting document on man's place in the world; deals with cosmic and biological evolution and environmentalism.

John Paul II. "Address to Pontifical Academy of Sciences" (on evolution). 22 October 1996. Available at: [www.ncseweb.org/resources/articles/8712\\_message\\_from\\_the\\_pope\\_1996\\_1\\_3\\_2001.asp](http://www.ncseweb.org/resources/articles/8712_message_from_the_pope_1996_1_3_2001.asp). Note that the pope spoke in French, and the initially published English translation contained a serious error, officially corrected, that misrepresented the pope's meaning by mistranslating the line "the theory of evolution is more than a hypothesis" as "more than one hypothesis in the theory of evolution." The site listed here gives the correct translation of "à reconnaître dans la théorie d'évolution plus qu'une hypothèse." See also *Quarterly Review of Biology*, below.

———. *Fides et ratio*. Available at: [http://www.vatican.va/holy\\_father/john\\_paul\\_ii/encyclicals/documents/hf\\_jp-ii\\_enc\\_14091998\\_fides-et-ratio\\_en.html](http://www.vatican.va/holy_father/john_paul_ii/encyclicals/documents/hf_jp-ii_enc_14091998_fides-et-ratio_en.html). Encyclical on faith and reason.

Larson, Edward J. *Summer for the Gods: The Scopes Trial and America's Continuing Debate over Science and Religion*. Cambridge, MA: Harvard University Press, 1997. Definitive and Pulitzer Prize-winning work on the Scopes trial.

Lindberg, David C., and Ronald L. Numbers, eds. *God and Nature: Historical Essays on the Encounter between Christianity and Science*. Berkeley, CA: University of California Press, 1986. Eighteen essays by eminent historians ranging over the 20 centuries of Christianity.

Osler, Margaret. "Science and Religion in Early Modern Europe." *History of Science* 36 (1998): 91–113. Argues for the "translation and appropriation" of ideas between science and religion.

### Supplementary Reading:

St. Augustine, *Confessions*. R. S. Pine-Coffin, trans. New York: Penguin Books, 1961. Most readable translation of this important work; easily available. Follow St. Augustine on his circuit of the late Classical world. Between the pious exclamations, this book gives a vivid view of the intellectual/philosophical marketplace of A.D. 400 and St. Augustine's real indebtedness to Classical thought.

Brooke, John Hedley, Margaret J. Osler, and Jitse van der Meer. *Science in Theistic Contexts: Cognitive Dimensions* (*Osiris*, vol. 16). Chicago: History of Science Society, 2001. Two introductory essays followed by 14 case studies of science/religion, including Judaism and Islam. Research-level papers from a conference.

Browne, Janet. *Charles Darwin: Voyaging*. Princeton: Princeton University Press, 1995.

———. *Charles Darwin: The Power of Place*. New York: Knopf, 2002. Browne's books are often considered the definitive biographical works on Darwin. The first volume (*Voyaging*) covers the period up to the publication of the *Origin of Species* (1859), while the second takes the story through the rest of Darwin's life. Very readable, engaging, and comprehensive.

Colling, Richard G. *Random Designer*. Bourbonnais, IL: Browning Press, 2004. Book by a microbiologist and conservative Christian who argues that the continuing flap over evolution and creationism is pointless and unnecessary; includes criticisms of intelligent design and the dangers of fundamentalist opposition to science.

Consolmagno, Guy. *Brother Astronomer: Adventures of a Vatican Scientist*. New York: McGraw-Hill, 2001. A popular book written by a Jesuit astronomer currently at the Vatican's Observatory, detailing his science (the study of meteorites), his life, and personal reflections on science and religion.

Cutler, Alan. *The Seashell on the Mountaintop*. New York: Dutton, 2003. Very readable popular book on the life and work of (the Blessed) Nicholas Steno, aka Niels Stensen.

Draper, John William. *A History of the Conflict between Religion and Science*. New York: Appleton, 1876. (Many later editions exist.) The book that started the conflict myth. Take a sense of humor and/or a stiff drink with this dated bit of melodrama.

Ferngren, Gary B., ed. *The History of Science and Religion in the Western Tradition: An Encyclopedia*. New York: Garland, 2000. An outstanding resource—more than 100 articles on various aspects of the science/religion issue. Much more than an “encyclopedia”; every entry is highly readable and informative. A fast and effective method of learning about a great many aspects of the topic.

Fleming, Donald H. *John William Draper and the Religion of Science*. New York: Octagon Books, 1972. The only book-length treatment of Draper; now a bit dated in some respects but with excellent use of archival material.

Funkenstein, Amos. *Theology and the Scientific Imagination from the Middle Ages to the Seventeenth Century*. Princeton: Princeton University Press, 1986. A masterful treatment of the impact of theological ideas and methods on scientific ones, including Christianity, Islam, and Judaism. A high-level text, it can be a difficult read, but it is a classic.

Gould, Stephen J. *Rocks of Ages: Science and Religion in the Fullness of Life*. New York: Ballantine, 1999. The author presents his NOMA formulation in this popular book.

Halley, Edmund. “Some Considerations about the Deluge.” *Philosophical Transactions of the Royal Society of London* (1694): 118–123. Halley's suggestion that the collision of a comet with the Earth caused the axial tilt and Noah's Flood.

Howell, Kenneth J. *God's Two Books: Copernican Cosmology and Biblical Interpretation in Early Modern Science*. Notre Dame, IN: Notre Dame Press, 2002. Definitive work on the wide varieties of biblical interpretation—Catholic and Protestant—of the 16<sup>th</sup> and early 17<sup>th</sup> centuries and the relationship to the new cosmology of Copernicus. Essential background to the Galileo affair.

Kragh, Helge. *Cosmology and Controversy: The Historical Development of Two Theories of the Universe*. Princeton: Princeton University Press, 1996. Excellent coverage of the steady-state versus Big-Bang models of the universe. Deals predominantly with the scientific issues but includes a few sections on the theological impacts of each.

Lindberg, David C., and Ronald L. Numbers. “Beyond War and Peace: A Reappraisal of the Encounter between Christianity and Science.” *Church History* 55 (1986): 338–354. Critique of White's warfare model.

———, eds. *When Science and Christianity Meet*. Chicago: University of Chicago Press, 2003. Collection of 12 essays by eminent scholars on Christianity and science from the patristic period to the 20<sup>th</sup> century. Similar to *God and Nature* by the same editors.

Livingstone, David N., and Mark A. Noll. “B. B. Warfield (1851–1921): A Biblical Inerrantist as Evolutionist.” *Isis* 91 (2000): 283–304. Scholarly article on the developing evolutionary views of one of the main crafters of the doctrine of biblical inerrancy.

Marsden, George M. *Understanding Fundamentalism and Evangelicalism*. Grand Rapids, MI: Eerdmans, 1991. Definitive, highly readable work on the subject by the leading historian of the topic.

Numbers, Ronald L. *Darwinism Comes to America*. Cambridge, MA: Harvard University Press, 1998. Short survey of American attitudes to Darwinism (pro, con, and in the middle), how they evolved, and why.

———. *The Creationists*. New York: Knopf, 1992. Fascinating account of the rise of fundamentalism and allied creationism in the United States; highly detailed and written with an engrossing narrative style.

Principe, Lawrence M. *Aspiring Adept*. Princeton: Princeton University Press, 1998. A work predominantly on Boyle's interests in alchemy, but it also treats his interest in contacting angels and contains a transcription of his unpublished dialogue on communication with spirits using the philosophers' stone and how this is related to refuting atheism.



*Quarterly Review of Biology*. "The Pope's Message on Evolution and Four Commentaries." December 1997. (Available as a single issue from *Quarterly Review of Biology*, P. O. Box 37005, University of Chicago Press, Chicago, IL 60637.) French and English text of John Paul II's statement on evolution (see note under John Paul II, "Address," above), plus interesting comments from an ethicist, a historian/philosopher of science, and a science educator and an embarrassingly ignorant but mercifully short rant by Richard Dawkins.

Ross, Hugh. *A Matter of Days*. Colorado Springs, CO: Navpress, 2004. A publication by an evangelical striving to debunk Young-Earth creationism and a literal six-days interpretation of creation while still denying evolution. Not a historical work, but an example of the cross-currents among present-day biblical inerrantists.

Scott, Eugenie C. *Creationism vs. Evolution: An Introduction*. Westport, CT: Greenwood Press, 2004. A useful survey of the issues and history regarding current-day arguments; written in particular for schoolteachers.

Tompkins, J. R. *D-Days at Dayton: Reflections on the Scopes Trial*. Baton Rouge: Louisiana State University Press, 1965. Out of print, but borrow a copy especially to read the collected dispatches from the trial by the curmudgeonly Sage of Baltimore, H. L. Mencken.

William of Conches. *A Dialogue on Natural Philosophy (Dragmaticon Philosophiae)*. Italo Ronca and Matthew Curr, eds. South Bend, IN: University of Notre Dame Press, 1997. A very readable translation that provides a fine sense of the use of *naturalism* in medieval natural philosophy.